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## AGROTECHNOLOGY

### USE OF PHEROMONES TO FIGHT PESTS EXPLAINED

Tallinn SOVETSKAYA ESTONIYA in Russian 17 May 83 p 3

[Article by D. Granat, senior scientific associate EstNIINTI--not further identified--possibly an Estonian research institute for technical information--, candidate of chemical sciences: "Pheromones Against Pests".]

[Text] The protection and guaranteed preservation of crops is an enormously important task. Economists have estimated that from 20 to 30 percent of the world's available crops are lost every year to harmful insects, weeds and disease.

Flying and crawling pests devastate fields and gardens and annihilate orchards and forests. The Colorado potato beetle is the scourge of the potato, Anobidae perforate valuable kinds of wood, the apple worm destroys orchard fruit, and granary weevils do away with the grain in storage. Since the time when man first became involved with agriculture, he has had to struggle with these destructive beings. And man has not always emerged the victor in this struggle. An enormous arsenal of agents and methods have been tried to protect the agricultural crops and forests from harmful insects--from the ancient methods of picking the insects off by hand, or using their natural enemies, to the use of strongest modern toxic chemicals.

At first when chemical agents were discovered it seemed that all of our problems had been solved--powerfully acting insecticides rapidly and effectively destroyed pests, but an entire range of negative phenomena due to the extensive use of chemicals rapidly appeared: contamination of the environment, and poisoning of fish, birds, animals and man. Moreover, the enthusiasm for insecticides led to the emergence of insect populations that were resistant to the effect of toxic chemicals. Consequences such as these forced us to search for new ways to protect the crops and to limit the use of toxic chemicals.

Pheromones--chemical substances secreted by insects for communication among themselves--are an ecologically safe method for plant protection. Known pheromones are those of sex and aggregation, tracking, alarm, etc., which play an important role in insect lives. Man has been able to affect the behavior of insects and use pheromones in pest control by interfering in the pheromone relationship. Pheromones are not harmful or toxic compounds; they function as decoys. They are used to lure the pests into specially constructed traps in which the insects are caught. According to the number of insects caught it can be determined if there are any pests, the number of the population, growth dynamics and stage of development.



These data are proving useful for determining chemical treatment periods, their number and the amount of expended chemicals, making it possible to perform the treatments more efficiently and to lower the outlay of toxic chemicals.

Sex pheromones, which assure the important reproduction function, are biologically very active. Sex pheromones are most promising for the protection of plants from harmful insects.

The use of pheromones for protecting orchards from such widespread pests as the apple worm has proven particularly effective.

In cases where the insect population is not very high, pheromone traps are used for their control by trapping the males--the male vacuum method. Attractant (female sex pheromone) is placed in the trap, only males are attracted, the females are left without partners and they do not reproduce. Such traps replace chemical treatment in pest control. Yet another method in the use of attractants is the disorientation method. The pheromone source produces elevated concentrations of the substance in the atmosphere and under these conditions males cannot find partners, who in turn are not impregnated. Pheromones, therefore, are an excellent means for regulating the numbers of harmful insects.

Useful experience in the use of pheromones has also been amassed in the practice of the forestry industry in the control of Anobidae and bark beetles.

In our country, pheromones for 20 types of insect pests have been synthesized. Technology is being developed for their use against major garden and orchard pests: the apple, plum, pea and Eastern worms, the clover, garden and cotton worms, the leaf roller moth, click beetles and other insects. A large body of research on the development of pheromone preparations is being conducted at TGU [Tartu State University] in the organic chemistry department. Production of pheromone materials at the "Flora" POBKh [possibly, a Production Association for protection of agriculture] is based on the efforts of Tartu scientists.

"Flora" is one of several enterprises in our country engaged in the industrial production of preparative forms of pheromones for the apple worm and leaf roller moth. The range of pheromone preparations will be constantly expanding. In the near future "Flora" is planning to produce pheromone materials for the cabbage worm--a garden pest--and the bark beetle--scourge of the conifer forests. Later on, the enterprise plans to produce compounds for all major pests of the fields, orchards, forests and greenhouses of the republic.

A pheromone materials kit contains the following: 10 Atrakon A traps, Pestifiks adhesive, and 10 pheromone sources. The cost of the kit is 1.50 to 2.00 rubles. The preparations are good for a year. Pestifiks, an entomological adhesive, is as good as foreign analogs in terms of its properties. The traps are made of water-resistant cardboard. A layer of Pestifiks nondrying adhesive is applied to the interior surface and a pheromone source placed within. The pheromone source is a piece of rubber tubing, 15-17 mm long, containing 0.001-0.002 grams of an active substance. Flora supplies the following sources for the apple worm: Feroflor SR-2 for northern rayons, Feroflor SR-K for the southern ones. Feroflor SR-MK is a universal source; for the leaf roller moth--Feroflor KM-E and Feroflor KM-MK.

Pheromones are fairly simple to use. The traps are hung in the apple trees at a height of 1.5-2 meters and higher. Two traps per hectare are enough for control, and 30 for trapping. A special preparation form where the active substance concentration is increased should be used for disorientation. The preparations are absolutely safe and nontoxic. Feroflor is good for no less than eight weeks; after this the pheromone source should be changed to a new one. The use of pheromone materials in apple orchards in the Ukraine, Kazakhstan and Tajikistan has made it possible to save 67-83 rubles per hectare due to a reduction in the use of insecticides. The economic effect of using apple worm pheromones in Estonian orchards will apparently be no less than this.

Pheromones produced by Flora must also be brought to the attention of private gardeners. Amateur horticulturists can only obtain pheromone materials through horticulture cooperatives. Use of the traps is neither troublesome nor burdensome and results in saving "wormless" apples with no chemicals at all.

The arrival of spring is the time when one should think about a system for protecting future crops, and pheromone preparations will help in this, especially since pheromones for the major orchard pests--the apple worm and leaf roller moth--will be on the market.

Information on obtaining and using pheromone preparations can be obtained by writing: 202400, city of Tartu, 27 O. Lutsa St., POBKh Flora, shop No. 6.

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## ✓ IMPORTANT PROBLEMS OF THE VETERINARY SERVICES DISCUSSED

Moscow VETERINARIYA in Russian No 6, Jun 83 pp 3-6

[Article by A. D. Tret'yakov, Head of the Main Veterinary Administration of the USSR Ministry of Agriculture]

[Text] One of the problems defined by the Food Program of the country is to satisfy growing needs of the population in high-quality animal husbandry products. The most important directions for its solution are the transition to intensive methods and advanced technology in animal husbandry, increase in the number of cattle and raising the productivity of all types of cattle and poultry.

The program stresses the necessity of improving the reproduction of the herds and increasing the output of the young cattle, implementation of a system of veterinary preventive measures which will make it possible to lower the disease rate and death of cattle and fowl, and expansion and strengthening of the material base of the State Veterinary Services and enterprises for the production of biological preparations.

The majority of the workers of the veterinary services are faithfully fulfilling their duty ensuring the well-being of livestock farms in their areas.

Vladimir Nikitovich Sharlay's name is known throughout the country. He is chief veterinarian of the kolkhoz "Leninskiy luch". For his excellent work indexes, he was one of the first to be awarded the USSR State Prize for 1982. The secret of his success is very simple: he loves and knows his job well, he has a deep feeling of personal responsibility for the work section entrusted to him, he does not tolerate shortcomings, he is full of initiative, he bluntly presents problems to the farm administration when they concern the health of the animals, and he works well with other people.

Veterinarian specialists of the following organizations deserve high praise: "Dobrynskiy" sovkhov, Perm Oblast, headed by Mal'vina Semenovna Ignat'yeva; Gukosyanskiy Rayon sovkhov, Armenian SSR, headed by Shota Karapetovich Kazaryan; Goritskaya Veterinary Laboratory, Mogilev Oblast, headed by Aleksandr Petrovich Sapego; "Uzbekistan" State Breeding Farm, headed by Veterinarian Khabib Rakhimovich Rakhimov; veterinary service of Gor'kiy Oblast, headed by Ivan Ivanovich Shamin, and hundreds of other teams and individual workers.

We recognize outstanding workers of the veterinary service. Their example and experience must be supported in every possible way and disseminated.

At the same time, we cannot be satisfied today with the quality of work of individual teams of the veterinary service. The absence of epizootic diseases at a farm has always been considered an indication of high effectiveness of preventive measures contributing to the development of animal husbandry. At the present time, it is one of the necessary conditions of successful fulfillment of the Food Program of the country.

Veterinary science and practice have accumulated much experience in controlling infectious diseases of animals. It makes it possible to conduct preventive and sanitation work purposefully, as a result of which the disease rate in the entire group of infectious diseases of animals has been steadily decreasing at least during the last 15 years.

However, in the light of today's problems we have no right to have any delusions regarding the state of affairs in this area of our activities. While critically evaluating the condition of the farms with respect to infectious diseases of animals, it is necessary to note that quite often there are serious shortcomings in the antiepizootic work, there are instances of violations of quarantine measures in disease foci and delayed diagnosis. This explains the occurrence of infectious diseases at some farms while the number of sick animals decreased for the country as a whole.

When there is a high concentration of animals and the herd is affected considerably, particularly when pathologoanatomic changes characteristic of tuberculosis are revealed in the animals, the most economically and epizootically optimal and radical way of sanitation is total simultaneous replacement of the livestock. However, local agencies sometimes select a method of studies which does not justify itself under such conditions, with subsequent gradual slaughtering of sick animals, keeping sick cattle too long.

The same applies to brucellosis, for which a negative role is played by delayed removal of clinically sick animals from the herd, unsystematic vaccination of cattle, and poor protection of the farms from infection. In controlling brucellosis, vaccinoprophylaxis should be planned and used in such a way as to accelerate the sanitation process. It is necessary to stop any violations in this respect, to hold people responsible for observing the instructions, and to eradicate preferential treatment and passiveness in the implementation of complex plans for the sanitation of farms and rayons.

In industrial livestock breeding, there are instances of appearance of some infectious diseases at the farms with affections of gastrointestinal and respiratory organs (colibacteriosis, paragrippe and others). The epizootic state of large specialized cattle raising farms, complexes and poultry farms must be under special control of veterinary agencies. It is necessary to strengthen sanitary and diagnostic services at these enterprises and to use more widely advanced technological methods in controlling infectious diseases of cattle and poultry.

It is also necessary to give more attention to the veterinary state of subsidiary farms of industrial enterprises and cattle owned by individuals.

Veterinary specialists engaged in fish farming who accumulated certain experience in maintaining fish breeding ponds must contribute to the fulfillment of the Food Program. State veterinary supervision of fish breeding ponds is well organized in the Lithuanian SSR, in L'vov Oblast and Stavropol'skiy Kray.

It is necessary to augment the role of veterinary laboratories. These institutions, particularly rayon and interrayon, have not yet become centers of prophylactic work and sanitation measures based on a system of diagnostic studies. At a number of places, the training and retraining of laboratory workers is poorly organized and new methods of studies are introduced slowly. It is necessary to increase the significance of laboratories in controlling animal diseases and to use the experience and knowledge of specialists working there in fulfilling the urgent tasks of the veterinary service.

Today, it is quite natural to require more attention from veterinary specialists, both practical workers and scientists, to the problem of noncontagious diseases. In order to lower diseases caused by disturbances in the metabolic processes, it is important to separate dry cows and pregnant young cows, as well as milking cows and young cows into separate production groups and feed these animals with consideration of their physiological state. These technological characteristics are taken into account in the flow-line sectional system of dairy farming. It is used widely in the kolkhozes and sovkhozes of L'vov and Ternopol' oblasts of Ukrainian SSR, Moscow, Ul'yanovsk, Leningrad and Voronezh oblasts of the Russian Federation, Lithuanian SSR and many others.

Practice shows that prevention of diseases of young animals and postnatal diseases of cows can be ensured only if calving is organized in special delivery sections with individual stalls and calves are kept in dispensaries where the "all empty -- all occupied" requirement is strictly observed.

The work in the prevention of postnatal complications in cows is well organized on the farms of the Lithuanian SSR, where systematic early gynecological prophylactic examination of cows is introduced. It is not accidental that the effectiveness of therapeutic measures for the republic is over 85%, and 90-95% in Klaypedskiy, Shaulyayskiy and Kapsuskiy rayons.

In the zones of the developed sheep breeding and cattle breeding at distant pastures, veterinary treatment and disease prevention stations proved to be very effective. Due to the advantages of this system, the therapeutic effectiveness of sheep diseases in the Krasnokutskiy and Yermakovskiy rayons, Pavlodar Oblast, exceeded 97% in the last few years. At the "Khar'kovskiy" sovkhoz, Krasnokutskiy Rayon, it was 100% for horned cattle in 1981.

It is necessary to strengthen the available veterinary treatment stations, to disseminate their experience and, where the local characteristics permit it, to use more extensively this advanced form of the organization of veterinary services to animal husbandry.

In order to solve the above and other problems, it is necessary to enhance the importance of veterinary sanitation on farms, as well as at enterprises processing animal husbandry products and raw materials. The veterinary science and practice are faced with the problem of intensive development and introduction of

a complex of sanitary measures, prevention of environmental pollution by animal husbandry wastes and improving the sanitary quality of farm products.

Solution of these problems must start with the use of advanced methods in designing, reconstruction and construction of animal husbandry enterprises and their operation under constant control by the state veterinary service. This is a necessary condition for ensuring high standards in the animal husbandry.

Much attention to the construction of farms and complexes and to the use of standard designs is given by the veterinary personnel of the Uzbek SSR, Belorussian SSR, Estonian SSR and Lithuanian SSR. However, the absence of control on the part of the veterinary service of the Dagestan ASSR led to the fact that some dairy farms were built without barns for young animals, manure removal systems and equipment in milking units do not operate well because the builders did not follow the design, and sanitary prevention and disinfection facilities were not used everywhere for the purposes they were intended for.

At the milk complex "Chebarkul'skiy", Chelyabinsk Oblast, there is no division into sections for cows which are about to give birth and for those giving birth. The veterinary dispensary also is not divided into sections and the "all vacant -- all occupied" principle is not observed. It is often difficult to correct the mistake made during the construction of livestock breeding facilities if there are already operating, which lowers the productivity of the animals and increases their disease rate.

State veterinary oblast inspectors do not always try to understand the problems of the construction of livestock farms, complexes and poultry farms and do not require head veterinarians of rayons to monitor their construction. The same refers to monitoring of the operation of livestock breeding facilities.

It should be required that the construction of each new facility for animals be under close veterinary supervision. Veterinary agencies and head veterinarians of rayons should actively interfere in these affairs, exercising widely the rights given them by the USSR Veterinary Statute.

There are many examples of effective struggles for high sanitary standards of farms. In the Rybnitskiy Rayon, Moldavian SSR, veterinary and sanitary measures became a necessary link with technology at livestock raising farms, and sanitary prevention and disinfection facilities and other veterinary objects are functioning everywhere. Systematic work is being done on the prevention of mastitis in calves. The rayon farms preserved 98.6% of horned cattle and 97.8% of pigs; 96 cows were obtained from each 100 cows; 97% of the milk delivered for processing is evaluated as first and second grades.

Milk of a high sanitary quality is sold to the state by many kolkhozes and sovkhoses of the Estonian SSR, Latvian SSR, Lithuanian SSR, and a number of oblasts and krais of the Russian Federation, Ukrainian SSR and Belorussian SSR.

However, against the background of these positive results, it should be mentioned that low-quality products are delivered to processing enterprises by the farms of the Kazakh SSR, Kirghiz SSR and Armenian SSR.

It is advisable for the livestock breeders of these republics to use the experience of the organization of public reviews and competitions of the sanitary state of dairy farms, the observance of the production technology on them, the use of various forms of process control; conducting "quality days"; organization of socialist competitions, and the creation of headquarters and councils on milk quality. Positive experience in this respect has been accumulated in the Vitebsk and Grodno oblasts of the Belorussian SSR, L'vov and Dnepropetrovsk oblasts of the Ukrainian SSR, and in the Rostov, Lipetsk, Moscow and a number of other oblasts of the Russian Federation.

In order to improve the sanitary state of livestock farms, it is very important to enhance the role of self-supporting veterinary and sanitary units. This is an advanced form of the organization of sanitary jobs. The labor productivity and output per one special-purpose vehicle in self-supporting units are 3-4 times higher than in disinfection units of enterprises, in organizations of the state veterinary network and on farms.

The problem of protecting horned cattle against hypodermosis still remains as important as before. In recent years, the affection of animals by this invasion has lowered but the appearance of hypodermosis on a number of farms of the Lithuanian SSR which were rendered safe in this respect and the increased affection rates of horned cattle at some farms of the Belorussian SSR confirm how important it is to fulfill the requirements of the instruction for controlling this invasion even when there are few gadflies.

Veterinary well-being of animal husbandry depends greatly on the organization and the level of the state veterinary supervision over transportation and the state boundaries. As a result of the strengthening of the veterinary and sanitary requirements and the improvement in the quality of the inspection of cargoes during dispatching and en route, in 1982 there was not a single case of the importation and spread of highly contagious diseases of animals on farms, good quality of the transported raw materials was maintained, and the loss of cattle during transportation was reduced.

At the same time, it is necessary to complain about violations of the rules and order of dispatching animals and cargoes, as well as the issuance of veterinary documents by territorial agencies, specialists of farms and enterprises.

The control of the sanitary conditions of storing bases and other enterprises for storing and processing of imported products and raw materials of animal products in the systems of the consumer cooperatives is weak.

Control and verification of the fulfillment are the important key factors of controlling the veterinary service and the conditions of each fulfillment of the tasks. They make it possible to reveal timely and remove the shortcomings with the consideration of the situation for correcting the work and increase its effectiveness. Control is a means of instilling in each worker the feeling of responsibility, efficiency and discipline.

In the light of the tasks provided for by the Food Program, it is necessary to observe the activity of all sections of the system of the state veterinary control.

This work is well organized in the Novgorod and Vologda oblasts, Tatar ASSR, in the Lithuanian SSR, and individual oblasts of the Ukrainian SSR.

At the same time, serious defects have been discovered in the activities of the state veterinary inspections of the Azerbaijan SSR, Georgian SSR, Kazakh SSR, Kirghiz SSR and Tajik SSR, as well as in the work of inspectors of individual oblasts of the RSFSR.

Chief state veterinary inspectors of the republics, krays and oblasts have to intensify the control over the fulfillment of the plans of the prevention and elimination of animal diseases, to use more fully the control over the work of veterinary services and other ministries and departments, to improve information and publicity of the results of inspections, to display more initiative in eliminating the shortcomings, and to present proposals for improving animal husbandry services for the examination of Soviet agencies.

The principle of high requirements for administrators and specialists in combination with the development of the feeling of responsibility in them for the fulfillment of the USSR Veterinary Statute must be the basis for the activities of the state veterinary inspectors of all levels.

One of the most important reserves of the national economy of the country is the acceleration of the scientific and technological progress, extensive and rapid introduction into production of the achievement of science, technology and advanced experience, and effective utilization of the material and labor resources.

Scientists have to ensure the development and introduction of advanced methods and means of preventing and curing animal diseases, effective biological and chemical therapeutic preparations and technologies of their production, instruments and devices for mass studies and processing of animals and the development of theoretical studies.

In the two years of the five-year plan, the following were introduced: a vaccine for the prevention of infectious rhinotracheitis of horned cattle, a set of antigens and serums for the diagnosis of horse gripe, vaccines against trichophytosis of horses, fur-bearing animals and rabbits, polyvalent serums and vaccine against colibacillosis, a complex allergen of atypical mycobacteria for the diagnosis of tuberculosis, a scientifically substantiated system for controlling brucellosis and tuberculosis in animals, new methods of disinfection and a number of other recommendations increasing the reliability and quality of veterinary measures.

At the same time, it is necessary to give more attention to the solution of a number of important problems of applied nature. The plans of scientific studies do not always provide for achieving concrete indexes, which lowers the effectiveness of scientific investigations and the responsibility of individual scientists for the results of their work.

We cannot tolerate the situation when scientists cannot offer in the course of many years specific means of preventing certain diseases of pigs of viral etiology, when causes of a number of diseases in sheep breeding complexes remain unstudied, when enterprises of the biological industry slowly assimilate the



production of new preparations, and the problems of controlling certain diseases of fur-bearing animals, fish and bees are not solved adequately.

Scientists should speed up the development of better methods for the diagnosis and a system of health improving methods for infectious diseases, to concentrate their attention on the improvement of the technology of the production of biological preparations and methods of their control and to take measures for providing biological plants with highly effective production and control strains of microorganisms.

The leading institutes and coordination councils have to establish strict control over the fulfillment of planned scientific studies and introduce actively completed research into practice. The veterinary department of VASKhNIL [All-Union Academy of Agricultural Sciences] must actively contribute to the input of scientists into the solution of problems provided for by the USSR Food Program.

In the light of the directions of the May and November (1982) Plenum of the CPSU Central Committee on the realization of the USSR Food Program, it is necessary to improve the organizational basis of the state veterinary network, to coordinate with the new form of controlling agricultural production -- agroindustrial associations, to strengthen the personnel of kolkhozes and sovkhozes, to continue the creation of diversified veterinary stations, hospitals, laboratories and equipping them with modern equipment.

It is necessary to intensify the work for improving the sanitary standards at animal raising farms, complexes and poultry farms, to achieve a high sanitary quality of animal-husbandry production, to organize reliable services for animals in subsidiary agricultural industrial enterprises and establishments and in personal subsidiary farms of the population, to achieve careful and rational utilization of treatment and prophylactic agents, to intensify the aid of scientific establishments to kolkhozes, sovkhozes, agricultural and veterinary agencies in measures for creating healthy herds of animals. Every veterinary worker and every team of the veterinary service must be well aware of the concrete tasks for 1983 applicable to the goals of their enterprise and establishment.

It is necessary to stand on principles and be uncompromising in relation to negative phenomena, to struggle for a high socialist discipline in all teams, labor, planning and state discipline, and to combine exactingness with stimulation of initiative and good performance of work. The demand for good performance of an entrusted job is, in the final analysis, the training in work discipline.

All measures of the veterinary service must be directed toward the growth of the number of cattle, increasing its productivity and, in the final analysis, the fulfillment of the production plan of the animal husbandry industry.

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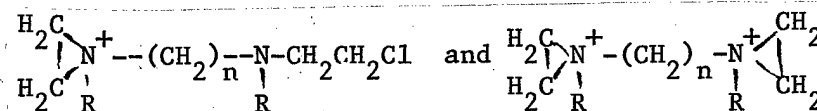
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## CHOLINESTERASE INHIBITION BY AZIRIDINIUM DERIVATIVES OF POLYMETHYLENEBISCHLOROETHYLAMINES

Moscow BIOORGANICHESKAYA KHIMIYA in Russian Vol 9, No 7, Jul 83  
(manuscript received 26 Apr 82, after revision 18 Jan 83) pp 926-935

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[Abstract] The inhibitory effect of polymethylenebischloroethylamines (PMBCA) on acetylcholinesterase from human blood erythrocytes and on horse serum butyrylcholinesterase was studied. The PMBCA obtained were active in their cyclic aziridinium forms:



where n and R are respectively: 10, CH<sub>3</sub> (A-7); 6, CH<sub>3</sub> (A-9); and 6, CH<sub>2</sub>C<sub>6</sub>H<sub>5</sub> (A-10). Optimal cyclization reaction occurred in 40-45 min at 37°C and pH 7.3. Experimental results showed that these cyclized agents are highly active reversible inhibitors of the cholinesterases studied ( $K_1 \sim 100\text{-}1 \mu\text{M}$ ) and at the same time exhibit time-related increase of irreversible alkylating activity ( $k_{II} \sim 10^2 \text{ M}^{-1}\text{m}^{-1}$ ). This irreversible inhibition results from alkylation of the functional groups at the surface of cholinesterases. The most effective alkylating agent was aziridinium analog of hexamethonium A-10. In general, the bimolecular constants of cholinesterase alkylation rates changed symbatically with the constants of irreversible inhibition when n and R were varied. Some speculative ideas were presented on the alkylation of the catalytic and regulatory centers by the compounds studied as a possible mechanism of the inhibition of cholinesterase. Figures 3; references 22: 10 Russian, 12 Western.

[599-7813]

## IMMOBILIZATION AND PROPERTIES OF IMMOBILIZED STREPTOKINASE ON INSOLUBLE CARRIERS

Kiev UKRAINSKIY BIOKHMICHESKIY ZHURNAL in Russian Vol 55, No 3, May-Jun 83  
(manuscript received 30 Jun 82) pp 307-310

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[Abstract] Investigations were conducted on several methods of streptokinase immobilization and the effects of the coupling agents and carriers on the properties of the immobilized enzyme. Immobilization of streptokinase on cellulose activated by cyanogen bromide, and on aminoethylcellulose by means of glutaraldehyde or N-cyclohexyl-N'-[2-(4-morpholinyl)-ethyl]-carbodiimide, showed retention of 72.00, 73.00 and 100.00% of the activity of the soluble enzyme, respectively. The corresponding binding efficiencies of streptokinase to the carrier were 7.4, 33, and 50%. After ten repetitive uses the cyanogen bromide preparation retained more than 40% of original activity of the immobilized streptokinase, and was thus shown to be the most stable preparation. Glutaraldehyde preparations retained only 13% of the initial activity after five uses and the carbodiimide preparation lost all activity after a similar number of trials. Immobilized streptokinase preparations were more thermostable than the native protein. Figures 2; references 14: 6 Russian, 8 Western.

[630-12172]

## CLINICAL AND EXPERIMENTAL STUDIES ON USE OF IMMOBILIZED ENZYMES FOR LOCAL THROMBOLYSIS AND THROMBOGENESIS

Kiev UKRAINSKIY BIOKHMICHESKIY ZHURNAL in Russian Vol 55, No 3, May-Jun 83  
(manuscript received 10 Oct 82) pp 311-317

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[Abstract] Experimental studies conducted on dog femoral vein and artery demonstrated that fibrinolysin immobilized on Sephadex G25 was an effective agent in resolving experimentally-induced thrombi within 30 min of a single administration of 1500 U. Similarly, studies with immobilized thrombin showed such preparations to be effective hemostatic agents in canine models: administration of 1000 U/kg of Sephadex-bound thrombin stopped hemorrhage from surgical wounds in the thigh within minutes. Clinical trials were also conducted with Streptodecase (immobilized streptokinase, approved by the USSR Pharmacological Committee) in the treatment of pulmonary thromboembolism. A single administration of 3,000,000 U was effective in clearing the pulmonary

artery on the basis of angiographic data. These observations have demonstrated that immobilized enzyme preparations are potentially-effective therapeutic agents that are known to be less toxic, antigenic, and pyrogenic than the soluble enzyme preparations. Figures 5; references 25: 19 Russian, 6 Western. [630-12172]

METHODOLOGICAL APPROACHES TO STUDY OF FACTUAL NUTRITION OF POPULATION AND OF STATE OF ITS HEALTH DUE TO NATURE OF NUTRITION

Moscow VOPROSY PITANIYA in Russian No 3, May-Jun 83 pp 9-15

[Article by G. I. Bondarev and V. Ya. Vissarionova, Institute of Nutrition, USSR Academy of Medical Sciences, Moscow]

[Text] Nutrition is one of the principal factors determining all vital bodily functions. The immunobiological characteristics of the body, physical and mental activity, ability to work and productivity of labor, state of health and life expectancy all depend on nutritional status. To an ever-increasing extent, scientific research is showing a definite connection between violation of sound nutritional principles and the development of many diseases. Improper nutrition has a particularly harmful effect on metabolism and the condition of the cardiovascular system and digestive organs [1-3]. Early atherosclerosis, coronary insufficiency, myocardial infarction [4-8], hypertension [9, 10], secretory and motor functional disorders of the stomach and intestine and liver and pancreatic disease are the consequence of alimentary disorders [11-14]. The endocrine, nervous, excretory and other systems of the body are also impaired [15-17].

The government approach to solving food problems and the improved material welfare of the Soviet people have eliminated the social basis for the development of nutritional deficiency in the most serious forms of its manifestation, such as that due to lack of protein, vitamins, iodine, etc. These problems have not yet been solved for mankind as a whole--deficiency in energy, protein and iron is most frequently encountered in developing countries [18-20]. The sufficiently high level of nutrition in our country and in other economically-developed countries, however, cannot fully eliminate the danger of development of nutritional diseases.

At present, rapidly changing working conditions and the nature of man's work activity are having a substantial effect upon the development of alimentary diseases. Scientific and technological progress, mechanization and automation of production have brought about a sharp reduction in the relative importance of physical labor. Energy expenditures in the principal branches of industry are an average 3000-4000 kcal/day [21]. Often the caloric value of food eaten has exceeded man's energy expenditures, which has brought on the problem of overfeeding in our country and abroad. Against a background of increasingly

manifest hypokinesia, this has led to an increase in the number of overweight and obese persons [22]. The prevalence of nutritionally-based obesity in economically developed countries is an average 20-30 percent among the adult population [23-25]. In this regard, the increase in the number of obese children and adolescents is noteworthy. In the German Democratic Republic and United States obesity is encountered in 12 percent of the children; in Bulgaria it is 11.6 percent. According to epidemiology research data from the Institute of Nutrition, USSR Academy of Medical Sciences [26], 26 percent of people in a number of areas in the USSR suffer from obesity. The percentage of people who are overweight is even higher; together with the obese they comprise 50 percent of adults over the age of 18. A tendency toward an increase in the number of obese patients among the young has been noted.

The contemporary stage in the development of industrial production has been characterized by the fact that, in a number of fields, the job is accompanied by high pressure, resulting in an increase of psychoemotional stress on the body [27]. When nervous tension is present, practically all aspects of metabolism undergo one change or another [28-32]. The problem arises of sound nutrition for persons with moderate daily energy expenditures as well as for those whose occupation is accompanied by nervous tension.

With an increase in production forces in areas where there is intense industrial development, principally due to an influx from different climatic and geographic zones of the country, nutrition as a factor promoting adaptation to severe climatic conditions has acquired special significance.

Thus, the role of nutrition in providing a healthy active life for the body is a decisive one at any level of development and organization of society. When man's life activity changes, his factual nutrition and the amount of food that he eats also change. This means that there is a change in the ways in which consequences for violating the principles of sound nutrition manifest themselves.

Therefore one of the most important tasks of hygiene is to constantly improve and unify methods for evaluating the status of nutrition and health of the population for timely diagnosis when nutrition deviates from that dictated by conditions.

The state of nutrition can be characterized by the sum of indices of factual nutrition, physical development and the health of the population. When studying the status of nutrition of collectives, socio-demographic factors must also be studied: sick rate and work time lost, mortality rate, life expectancy, labor productivity, etc. [33, 34].

/Methods for evaluating adequacy of nutrition to meet demands of the organism. Factual nutrition./ [Passage in slantlines printed in italics]. The study of factual nutrition (regimen, chemical composition, food energy value) is undertaken to uncover nutritional deficiencies and correct and eliminate them according to living conditions.

The questionnaire survey method, which is widely used at present in our country and abroad, was developed in studies by many authors. In comparison to other methods it is relatively simple and efficient. Necessary information concerning

the nutrition of individuals, families and also collectives can be obtained within a relatively short period by using specially constructed questionnaires. It has been found that in 79 percent of cases an active survey supplies reliable material for obtaining group data on quantitative and qualitative characteristics of factual nutrition [35]. This makes it possible to use the questionnaire survey method to study the state of nutrition of large groups of the population.

A precise system of sampling is used in order to increase the degree of reliability of data obtained. The group studied must be homogeneous in terms of age and sex, level of physical development and health. All participants must have lived in a given area for no less than three to five years, to eliminate the effect on their health of a period of adaptation to new conditions. In studying the nutrition of occupational groups, length of service within a given occupation must be no less than three to five years, for the same reason. Homogeneity of the group in terms of national makeup must be maintained so that national nutritional traditions might be taken into account.

Accuracy in filling out the questionnaires must be carefully controlled and immediately verified every day.

In addition to the appropriate sampling method, the representative nature of the questionnaire survey method is determined by the required sample size. The size of the sample as a whole depends on the number of indices necessary, the average allowable error of an average value, measurement error and required degree of reliability. For the selection of representatives for the sample as a whole, a method of typical sampling (by area) followed by random (nonsystematic) or mechanical (systematic) sampling has been used [36].

The formula recommended by the Institute of Nutrition, USSR Academy of Medical Sciences, should be used to calculate the size of the sample [36]. Nutrition should be studied at two periods of the year to negate the effect of the seasonal factor: winter/spring and summer/autumn, in the most representative months of the given season. The length of the nutrition study of those surveyed must be no less than seven days in any period of the year, including days off, since this period gives a picture of typical food consumption [38, 39]. For nutritional patterns in the winter/spring period in the central climatic zone it is recommended to survey diets for one of the weeks in January/February and one of the weeks in April/May; for summer/autumn period--one of the weeks in July-August and one of the weeks in October/November.

For study of the nutrition of organized contingents of the population, it is recommended that the menu choices upon which the survey is based be chosen in succession. This way it is possible to establish uniformity in the food eaten.

A special chart for a medical survey of nutrition and health must include the following sections: a section containing personal data, nutritional data, energy expenditure data, patient health, etiological factors and a conclusion.

The personal data section shows surname, first name and patronymic of the subject, sex, age, occupation, length of service in a given specialty, length of residency in a given place.

The "nutritional information" section presents data for the week, including days off, on nutritional conditions (frequency of food intake; length of intervals between eating; availability of a nutrition schedule, e.g., eating on the night shift) and on the consumption of individual dishes and items, showing kinds and brand names.

In order to improve the precision of the quantitative characterization of nutrition, units of measurement for food are included. The use of volume measurements is recommended, spoon measurements (tablespoon or teaspoon), plates (deep, shallow), glasses (200-gram, thin, thick), in parts of a whole or in grams. Information on the weight of food products in the most frequently used volume measurements are presented in reference tables on the content of basic foodstuffs and the energy value of food [40]. The most accurate results can only be achieved when based on units of weight.

Correlation between factual nutrition and menu data (or the "nutrition information" section of the chart) must be checked periodically [41].

Nutrients, the requirement for which is set by physiological norms, must be considered compulsory indices in characterizing the chemical composition of a diet: total amount of protein and animal protein, total amount of fats, vegetable oils, amount of polyunsaturated fatty acids, vitamins B<sub>1</sub>, B<sub>2</sub>, B<sub>6</sub>, B<sub>12</sub>, PP, folic acid, C, A, E and D; of the mineral substances: calcium, phosphorus, magnesium and iron [42].

Based on data obtained from the "nutrition information" section, the researcher calculates the chemical composition and the caloric value of food consumed and makes an adjustment in accordance with results of laboratory analysis. Use of reference tables of chemical composition of food is recommended for the calculation [40, 43]. In the tables, the chemical composition of a product is given for its edible part; it is therefore necessary to take into consideration waste standards in the calculations. Use of the following energy value coefficients for basic food groups is effective in determining food energy value: for proteins 4.0 kcal/g (16.7 kJ/g), for fats 9.0 kcal/g (37.7 kJ), for available carbohydrates 3.75 kcal/g (15.7 kJ/g) [40].

Based on data obtained, the nutritional balance is analyzed according to basic indices: the relationship between total amount of proteins, fats and carbohydrates, between animal and vegetable protein, between animal and vegetable fats; between the total amount of calcium and phosphorus, calcium and magnesium. The energy value of proteins, fats and carbohydrates is determined in percentage of the daily caloric value taken as 100 percent, and the caloric value of individual food intake, in percentage of the daily value.

Calculated data obtained by studying daily food diets is correlated with accepted norms, for the country, of human physiological requirements for food substances and energy [42].



The "type of energy expenditure" section presents necessary data for a study of the adequacy of factual nutrition from an energy standpoint. Included are items enabling a determination of daily energy expenditure at work and at home. Study of the nutrition of collectives operating in industrial establishments demonstrates that they belong to the energy expenditure group of the adult population who are capable of working (according to the intensity of the work), according to classification established by the Institute of Nutrition, USSR Academy of Medical Sciences.

Daily expenditures of energy are determined by the researcher when necessary. The relatively simple "indirect" Douglas-Haldane method of calorimetry is widely used for this purpose [44]. It is based on the study of pulmonary gas exchange with subsequent calculation of the respiratory quotient and energy expenditures according to oxygen uptake.

The "expired-air gas-analyzer", types GVV-2 and GKhp-3M, are the easiest to use. The latter is the most suitable for operation in the field, because it is simple, light and safe to operate [45].

Total energy expenditure tests are preceded by time metering of the subject's activities. The purpose of this is to establish time necessary for different types of activity and various body states (sleep, rest, etc.), during work and non-work time. For a calculation of allotted work time, it is convenient to use the job evaluation manual and descriptions of the technological process. As a rule, time off from work is calculated on the basis of records kept by the subject according to a previously established plan. Calculations of energy expenditure in free time has been made according to generally accepted energy equivalents [46]. Energy expenditures per day are expressed in kilocalories (and kilojoules) for men weighing 70 kg or women weighing 65 kg.

Twenty-four hour expenditure is compared with actual consumption of energy with food.

The social and hygienic significance of the questionnaire survey method gives more opportunities for using information on the state of the population's health. Health evaluation as an index of the state of nutrition must be based on certain criteria. This means that test methods that are suitable for identifying various types of nutritional deficiencies must be used.

Body measurement and clinical factors are being used for this purpose. The body measurement factors characterizing the physical development of man are: height, body weight, weight/height index, thickness of the skin-fat fold and chest circumference [47-49]. Body weight data must contain the actual value and the value calculated by using A. A. Pokrovskiy's nomograph, allowing a man's ideal weight to be determined by taking into account his constitutional characteristics [50-51]. The creatinine coefficient is determined for analyzing the development of body muscle mass [52, 53].

The clinical exam is comprised of diverse diagnostic methods which must be used to expose pathological processes within the body that are nutritional in origin. General blood analysis should be done in all cases [54]; during the physical examination symptoms of nutritional deficiency, including vitamin deficiency, should be identified, as evidenced by: trophic skin disorders, petechiae, xanthelasma, hyperpigmentation and hyperkeratosis.

Psychophysiological characteristics must be determined and autoregulatory reactions studied. The procedures used must be adequate to meet the requirements of the circumstances studied (particularly the job) and for those bodily functions which undergo stress under these conditions. For example, for conditions (of work) with a predominantly mental component and with great stress on the central nervous system and analyzers, methods for studying the functional condition of the central nervous system and psychoneurological evaluation, as well as observation of the function of the circulatory organs, would be adequate. The state of the central nervous system must be analyzed in all cases [55].

Autoregulatory reactions are studied according to the state of nervous and endocrine regulation of metabolism.

One of the basic criteria for evaluating nutritional status is the study of physiological and biochemical adaptation of the body to a change in nutritional circumstances by using immunobiological tests and biochemical metabolic indices. The high sensitivity of the tests characteristic of state of specific and non-specific immunity has been shown with nutritional deficiencies of varying degree [56, 57].

Early premorbid symptoms of disorders in separate components of metabolism caused by improper nutrition can be identified by using appropriate biochemical test methods. Procedures for determining end products of metabolism in the urine, specific metabolites in the blood, blood enzyme activity and secretions of the gastrointestinal tract are used for this reason.

In order to measure protein metabolism, daily excretion in the urine of total nitrogen, urea, ammonia, amino nitrogen, creatinine and uric acid (calculation of the uric acid coefficient) are measured [58].

A definite relationship exists between the content within a diet of qualitatively-different fats and its caloric value with lipid metabolism indices [59-65] and also between the fat composition of the diet (quantitative and qualitative aspects) and the level of cardiovascular pathology [66-70]. The state of lipid metabolism in the body is characterized by the content of total lipids, cholesterol, triglycerides, lipoprotein fractions and phospholipids (calculation of the phospholipid/cholesterol coefficient) [71].

One of the indicators of the state of the carbohydrate metabolism regulatory mechanisms is the blood sugar level. Changes in carbohydrate metabolism can also be detected by the level of pyruvic acid in the blood and urine and bisulfite-binding substances in the urine [41].

Basic indices characterizing the state of vitamin metabolism are: level of vitamins C and A, carotenoids, blood serum D and E, activity of transketolase and glutathione reductase in the blood and of aspartate aminotransferase in erythrocytes, and the excretion of thiamin, riboflavin, 4-pyridoxic acid, N-methyl nicotinamide and vitamin C in the urine. If difficulties arise with getting a daily urine sample, then the provision of vitamins can be checked by the amounts of them excreted in morning (hourly) urine.

Calcium, phosphorus, chlorine and iron blood levels can be classified among the most important indices of mineral metabolism [72].

In the analysis of diseases it should be remembered that even straight-forward symptoms of unsound nutrition can be caused by reasons other than those of a nutritional origin [73]. For example, hypovitaminosis is caused not only by a nutritional vitamin deficiency, but also by disorders in their assimilation due to digestive organ disease. Therefore, the individual must undergo detailed interrogation concerning any chronic diseases that he has. This data is reflected in the "etiological factors" section of the medical survey (questionnaire) chart with the subdivisions: nutritional factor, (overeating, surplus of carbohydrates or fats, infrequent food intake, night eating, heavy drinking, excess of salt, alcohol abuse), endocrine disturbances, hereditary factor, infectious and other factors (diseases), attendant diseases (diabetes, hypertension, atherosclerosis, myocardial infarction, cholelithiasis, cholecystitis, polyarthritis, varicose veins, thrombophlebitis, endarteritis, etc.), psychoneurological factor (psychological traumas, nervous stress and exhaustion). The data obtained make it possible to determine the percent ratio of people who are healthy for all practical purposes and those with chronic diseases.

A conclusion as to the state of factual nutrition and the health of the population is formulated on the basis of data from all sections of the questionnaire.

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NUTRITIONAL VALUE OF PACIFIC OCEAN SEAFOODS

Moscow VOPROSY PITANIYA in Russian No 3, May-Jun 83 (manuscript received 20 Jan 83) pp 76-77

[Article by T. A. Braksh and E. N. Vasil'yeva (Moscow) discussing joint plenum on nutrition held at Vladivostok Medical Institute]

[Text] In September of 1982 a joint plenum of the section "Principles and Popularization of Sound Nutrition", the Scientific Council on the Problem Topic "Production of Food Products and Improvement of Nutrition of the Population of the USSR" of the GKNT [State Committee on Science and Technology], the USSR Academy of Sciences Scientific Council on Medical Problems of Nutrition and its constituent Problem Commission, "Theoretical Principles of the Assimilation of Food Substances and Medical and Biological Evaluation of New Sources of Food Substances" was held at Vladivostok Medical Institute.

Questions of medical and biological analysis and prospects for using new sources of food from the Pacific Ocean were discussed at the plenum. The significance of the questions on the agenda for the plenum is obvious, in light of tasks proposed at the CPSU 26th Congress and the May (1982) Plenum of the CPSU Central Committee providing the population of the country with all types of food and on improving the nutritional structure of the Soviet people by using products with better food values.

Reports were heard and discussed on providing protein to humans (V. A. Shaternikov, V. G. Vysotskiy, Institute of Nutrition, USSR Academy of Medical Sciences [IN-AMS] prospects for using in nutrition, new items from industry (V. P. Bykov, BNIRO [All-Union Scientific Research Institute of Sea Fisheries and Oceanography]; V. N. Akulin, TINRO [Pacific Ocean SRISFO]; I. I. Brekhman, Institute of Marine Biology, DVNTs [Far Eastern Scientific Center] USSR Academy of Sciences), medical and biological aspects of using products from the sea for human nutrition (V. A. Petrov, Vladivostok Medical Institute; P. N. Maystruk, Zh., B. Levinton, Kiev Scientific Research Institute for Nutritional Hygiene; M. M. Levachev; IN-AMS), and, also, the problems of guaranteeing the safety of marine products (V. A. Tutel'yan, V. A. Konyshev, USSR Academy of Medical Sciences).



A significant change in the qualitative composition of raw materials of the fish industry was noted. With the appearance of new industrial items comes the task of studying their physical, biochemical, nutritional, structural and mechanical and technological characteristics, and also of increasing the depth of research in the field of new types of food production technology and the use of new physical methods for processing the raw materials. However, the items of first priority are: analysis of the content of the most important food substances in new types of marine organisms, determination of the biological value of the protein, and also of their safety of consumption for men and animals.

The toxicity of many forms of sea animals and algae and the lack of reliable data on their safety for man has hampered the use of non-traditional types of marine products in human food. The long-term effect on man of biologically active substances of marine organisms has been dealt with especially little. It is necessary to take into consideration the fact that toxicity of a raw material can be substantially changed depending on food chains of organisms used as raw materials, and by the presence or absence of symbiosis of marine invertebrates with toxic algae, and on man-induced contamination introduced in water or through the food chain.

Wise use of the ocean's biological resources necessitates: a comprehensive approach to the study of the dangers of new industrial organisms, analysis of the economic effectiveness of their industrial processing, medical and biological analysis for their possible use as raw material for food and also development of a waste-proof technology for obtaining food products, protein isolates, lipids, polysaccharides and biologically active substances as raw materials for the pharmaceutical industry.

Basic directions in research in the field of new industrial products have been defined in a decree of the joint plenum. They include medical and biological analysis of the possible use of new types of marine organisms for nutritional and medical purposes and development of methods of classification, identification and quantitative determination of contamination of marine product. Specific tasks were given to the scientific collectives of the Institute of Nutrition, USSR Academy of Medical Sciences, the Kiev Institute of Nutritional Hygiene, UkSSR Ministry of Health, the VNIIGINTOKS [expansion unknown] of the USSR Ministry of Health and a number of other institutions.

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EXPERIMENTAL ASSESSMENT OF BIOLOGICAL EFFECTIVENESS OF PARTIALLY HYDROLYZED  
SOYBEAN AND CASEIN PROTEINS

Moscow VOPROSY PITANIYA in Russian No 3, May-Jun 83 (manuscript received  
31 Aug 82) pp 22-24

YATSYSHINA, T. A., VYSOTSKIY, V. G., SAFRONOVA, A. M. and YEGANYAN, R. A.,  
Institute of Nutrition, USSR Academy of Medical Sciences, Moscow

[Abstract] Protein hydrolysates of soybean 710 (Ralston Purina Company, USA) and casein were compared in terms of tolerance and assimilability by the body and of biological effectiveness. Participating in the experiments were 11 volunteers (7 men, 4 women) ranging in age from 25 to 49 years, with initial mean weight of  $69.6 \pm 3.0$  kg and mean height of  $171.2 \pm 2.6$  cm. Soybean hydrolysate was studied in the first period of 14 days and casein hydrolysate was studied in the second 14 day period. The body readily tolerated both proteins. Blood indicators remained within normal limits except for some reduction of the phosphorus level in the first period. Assimilability of soybean protein hydrolysate nitrogen was somewhat less than that of casein protein hydrolysate. Urea, ammonia and creatinine excretion was somewhat greater in subjects who consumed soybean protein hydrolysate. Some discomfort was noted after consumption of soybean protein hydrolysate which required limitation of its use as a nitrogen source in the diet. References 4 Western.  
[591-2791]

UDC 613.2:664.339:008] (47+57)

USSR FOOD PROGRAM AND NUTRITION POLICY

Moscow VOPROSY PITANIYA in Russian No 4, Jul-Aug 83 (manuscript received  
15 Sep 82) pp 3-5

PETROVSKIY, K. S., professor, Chair of Nutrition Hygiene, First Moscow Medical  
Institute imeni I. M. Sechenov

[Abstract] A synopsis is presented of the USSR Food Program and Nutrition Policy approved at the May 1982 Plenum of the CC CPSU. Basically, these directives recognize that although at the present time the population of the

USSR is provided with the required caloric intake, steps must be taken to insure that the calories are provided by high quality nutrients in terms of biological and nutritive value. Current estimates are that both industrial and agricultural workers expend about 3000 kcal/day (down from 4000 to 5000 kcal/day a century ago when labor was mostly manual) and the present sedentary lifestyle demands careful dietary planning for optimum health. The coordination of the various aspects of the nutrition policy rests with the State Committee for Science and Technology and the USSR Ministry of Health.  
[632-1272]

UDC 613.281:613.398.192

#### BIOLOGICAL CRITERIA FOR THE USE OF NEW PROTEIN SOURCES IN MEAT PRODUCTS

Moscow VOPROSY PITANIYA in Russian No 4, Jul-Aug 83 (manuscript received 17 Sep 82) pp 38-44

SAFRONOVA, A. M., SHATERNIKOV, V. A., VYSOTSKIY, V. G., CHOLAKOVA, A.\* and NESTEROV, \*N., Institute of Nutrition, USSR Academy of Medical Sciences; Institute of Meat Industry, People's Republic of Bulgaria

[Abstract] Theoretical considerations are provided for the rational utilization of nontraditional protein sources in the production of combined meat products meeting human requirements in essential amino acids. In using animal and plant sources of essential amino acids, two approaches can be taken in designing high-quality proteinaceous nutrients. One approach relies on the utilization of lower quality animal and plant to provide an excess or reserve quantities of essential amino acids in combination with animal meat and thereby enhance the value of the latter. Another approach relies on combinations that, taken together, will provide an appropriate balance and quantity of amino acids that meet human nutritional requirements. References 9: 3 Russian, 6 Western.  
[632-12172]

UDC 612.39+613.2]:601.8:65.012.2"1984"

#### MEETING OF SCIENTIFIC COUNCIL FOR MEDICAL PROBLEMS OF NUTRITION, USSR ACADEMY OF MEDICAL SCIENCES: RECOMMENDATIONS FOR SCIENTIFIC INVESTIGATIONS IN MEDICAL ASPECTS OF NUTRITION TO THE 1984 PLAN

Moscow VOPROSY PITANIYA in Russian No 4, Jul-Aug 83 pp 75-77

BRAKSH, T. A., Scientific Secretary of the Council

[Abstract] The Bureau of the Scientific Council for Medical Problems of Nutrition, USSR Academy of Medical Sciences, met on 9 Mar 83 to consider recommendations to be made to the 1984 Plan for the Problems of Nutrition. Within the framework of the "Theoretical Bases of Nutrient Assimilation"

research should be conducted on the significance of fibers in nutrition and on trace element metabolism. Furthermore, the "Vitaminology" program should consider the need for additional vitamin intake among certain segments of the population; evaluate the adequacy of folic acid intake by pregnant and breast-feeding women and the effects of folic acid on the progeny; deal with the development and standardization of analytical methods for vitamins in food products; and evaluate and substantiate the need for vitamin additives in extensively-used food products. Other recommendations deal with careful evaluation of various forms of diet therapy and nutritional status of children, and of the dietary means of disease prevention.

[632-12172]

## GENETICS

UDC 575.24:576.851

### UNSTABLE MUTANTS OF BACILLUS SUBTILIS INDUCED BY HERRING DNA

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR SERIYA B. GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 6, Jun 83  
(manuscript received 17 Jan 83) pp 66-70

KARPOVA, I. S., Institute of Molecular Biology and Genetics, Ukrainian SSR Academy of Sciences

[Abstract] The appearance of instability of leucine-dependent auxotrophs after exposure to herring DNA and not found in a control is described. Experiments utilized various strains of *Bacillus subtilis*. The initial museum monoclonal culture was implanted on agar, 50 typical colonies were selected and transplanted to dishes, with minimal media without leucine to count the revertants, and to dishes with the full medium to count viable cells. Revertants produced 30 to 80% of the viable cells, colonies appearing at various times and in various sizes. The superinstability of the genes is explained by integration of a fragment of the exogenous DNA in the area of the promotor, hindering transcription. It is assumed that, in the revertable leucine-dependent auxotrophs, the nucleotide sequence is not changed, while the mutant phenotype results from the interaction of the fragment of foreign DNA with the regular zone of the leucine operon. Figures 2; references 10: 7 Russian, 3 Western.  
[572-6508]

UDC 577.113.5

### DNA RECOMBINATION SITE IN TRANSDUCING PHAGE $\lambda$ plac5

Moscow BIOORGANICHESKAYA KHIMIYA in Russian Vol 9, No 5, May 83  
(manuscript received 7 Feb 83) pp 711-712

SHPAKOVSKIY, G. V. and BERLIN, Yu. A., Institute of Bioorganic Chemistry imeni M. M. Shemyakin, USSR Academy of Sciences, Moscow

[Abstract] Studies were conducted on the nucleotide sequence in the recombination site of phage  $\lambda$ plac5 by comparison of the *E. coli* lac operon (distal portion of lacZ gene, Z-Y spacer, and proximal end of lacY gene) with corresponding sequences of phage  $\lambda$ CI857 and phage  $\lambda$ plac5-2 (which retains two of the

five EcoRI sites found in  $\lambda$ plac5 DNA). The bacterial DNA insert was determined to terminate immediately after the Z-Y spacer, preceding the ATG initiating triplet of the lacY gene, but not involving the gene itself. The crossover region in the bacterial and phage DNA consists of a 20 bp segment which is adjacent in the  $\lambda$  DNA to a region with predominant GC pair ratio, and in the bacterial DNA with a preponderance of AT pairs. The bacterial DNA contains two additional AT basepairs which presumably serve as a signal for the recombination enzymes and determine the specific site (crossover site) of endonuclease attack. The second recombination site in  $\lambda$ plac has been localized close to the site of action of HindII (nucleotides 854-859 of lacI gene). Delineation of the sites may contribute to an understanding of the anomalous exclusion of phage  $\lambda$  from the bacterial chromosome, which results in the formation of transducing phages. Figures 1; references 12: 1 Russian, 11 Western.  
[633-12172]

PLAGUE RESEARCH IN THE USSR

Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII in Russian  
No 2, 1981, No 1, No 8, 1982

UDC: 576.851.45.095.57

PERSISTENCE OF L FORMS OF YERSINIA PESTIS IN EXPERIMENTAL ANIMALS

[Article by G. S. Dunayev, L. F. Zykin, S. V. Prozorovskiy, V. M. Kostyukovskiy, V. S. Rybkin and M. Ya. Kulakov, Volgograd Scientific Research Institute for Plague Control and Institute of Epidemiology and Microbiology imeni Gamaleya USSR Academy of Medical Sciences, Moscow, No 2, 1981 (manuscript received 7 Jan 80) pp 19-22]

[Text] The prolonged survival of microorganisms in organs and tissues plays an important part in both the pathogenesis of infectious diseases and their epidemiology and epizootiology.

Persistence of L forms of streptococci in the course of long-term experiments has been demonstrated by Timakov et al. [6], Vul'fovich [1], Shaulauskene [7] and a number of other researchers. It was established that L forms are capable of surviving in the body for a long time, and that they play an appreciable role in development of chronic diseases.

Although plague is a classic example of an acute infection, some authors deem it possible to attribute the prolonged persistence of the pathogen of plague in rodents to the existence of atypical forms of the species [2, 5]. There are data to the effect that there are long-term human *Y. pestis* carriers during epidemic outbreaks [3]. The assumption had been repeatedly voiced that L forms of *Y. pestis* are capable of playing a substantial role in maintaining the infection. However, there is no factual proof of this.

In our previous work [8], we described methods of recovering L forms of *Y. pestis* and the morphological changes occurring during L transformation. We report here on a study of the possibility of persistence of L forms of *Y. pestis* in experimental animals.

Material and Methods

We used L forms of *Y. pestis* induced with penicillin in liquid media, with tryptic digest of bovine myocardium, 15% saccharose, 20% normal horse serum

and 1% hemolyzed blood to infect animals. The parent strains, from which L forms were obtained (Table 1), fermented glucose, maltose, mannitol, glycerin; they do not decompose saccharose, lactose and urea, had no denitrifying activity and were highly sensitive to *Y. pestis* and *P. pseudotuberculosis* phages.

Table 1. Principal properties of original strains of *Y. pestis*

STRAIN NUMBER	ORIGIN OF CULTURE	YEAR OF ISOLATION	MAIN PROPERTIES	VIRULENCE FOR GUINEA PIGS AND MICE
1178	CENTRAL ASIAN SITE	1963	FI-T+P-vw+	-
134		1767	FI+T+P-vw+	-
1762		1973	FI+T+P+vw+	+
1591		1961	FI+T+P-vw+	-
1589		1960	FI+T+P-vw+	-
197	VOLGA-URALS SITE	1967	FI-T+P-vw+	-
282		1961	FI+T+P-vw+	-

Key: FI<sup>+</sup>) strain forms specific capsular antigen  
T<sup>+</sup>) forms murine toxin  
vw<sup>+</sup>) indicated antigens are present  
P<sup>+</sup>) form pigment on Jackson's medium  
-) avirulent strain  
+) virulent strain

In liquid media containing penicillin in concentrations of 3 to 1000 AU [active units]/ml, all of the strains of *Y. pestis* L forms developed in the form of branching structures consisting of filaments and various spherical elements. When plated on semiliquid media, they grew in the form of individual grayish-white pinpoint colonies consisting mainly of spherical and granular structural elements (Figure 1a [none of figures mentioned is reproduced]).

In our study of persistence of L forms of *Y. pestis* in susceptible animals, we used 5 L cultures of the 36th passage (1178-L, 134-L, 1762-L, 1591-L, 1589-L) and 2 cultures recovered after the 20th passage (197-L and 282-L). The 36th passage L forms did not grow on Hottinger's agar with added sodium sulfite and lyzed blood; they were replated on semiliquid media without adding penicillin for several passages, and no instances of reversion to the bacterial form were observed. L cultures of the 20th passage reverted to bacterial forms after 2-3 platings in media without penicillin.

Before use to infect animals, all of the original *Y. pestis* strains and L forms obtained from them were tested for capacity to synthesize species-specific antigens: capsular (fraction I) and murine toxin.

Fraction I was demonstrated using the indirect hemagglutination test (IHAT) with commercial plague antibody erythrocytic diagnosticum produced by the Alma-Ata Plague Control Institute. It was shown that the initial strains of *Y. pestis*, with the exception of two that were not separated--Nos 197 and 1178--had the capacity to synthesize capsular antigen in concentrations of  $10^7$  to  $1.25 \cdot 10^5$ , whereas this antigen was not demonstrable in L cultures.



The results of the IHAT were confirmed by fluorescence microscopy using fluorescent *Y. pestis* species-specific antibodies. Under the effect of this serum, there was no specific fluorescence in elements of L cultures.

Murine toxin was demonstrated with the IHAT with use of an experimental specimen of *Y. pestis* erythrocytic diagnosticum. The findings revealed that L forms of *Y. pestis* retained a marked capacity for synthesis of species-specific murine toxin antigen; only one strain (No 1762) synthesized this antigen to a lesser degree (to  $5 \cdot 10^8$  versus  $5 \cdot 10^5$ ).

Table 2. Results of testing L forms of *Y. pestis* isolated from guinea pigs using specific fluorescent *Y. pestis* serum

METHOD OF DEMONSTRATION	TIME OF NECROPSY ON INFECTED ANIMALS	STRAINS USED FOR INFECTION						
		1178-L	134-L	1762-L	1589-L	1591-L	282-L	197-L
WITH USE OF SPECIFIC LUMINESCENT SERUM	10	3/4	1/3	1/4	0/4	2/3	1/3	0/3
	20	1/2	1/2	1/3	2/3	2/7	0,1	1/3
	30	1/4	0/3	0/3	1/2	0/2	0,4	1/3
INDIRECT HEMAGGLUTINATION TEST	10	2/4	0/3	1/4	0/4	0/3	1/3	0/3
	20	1/2	1/2	0/3	2/3	2/7	0/1	1/3
	30	0/4	0/3	0/3	1/2	0/2	0/4	1/3

The next stage of our studies was to examine persistence of L forms of *Y. pestis*. For this purpose, we infected guinea pigs weighing 250-300 g intra-peritoneally in a dosage of  $0.5 \cdot 10^8$  bacterial cells (18 animals for each strain). They were under observation for 1 month, and then 6 guinea pigs were sacrificed every 10 days. We examined their spleen, blood serum and kidneys. Concurrently, we determined whether the bacterial form of *Y. pestis* was present using the method described in a textbook on plague prevention [4].

After plating 104 samples on semiliquid (0.3%) agar without penicillin, we observed primary growth of microorganisms, as manifested by diffuse clouding of the medium with formation of a film on the surface. No growth was found in 66 specimens, when primary cultures were transferred to semi-solid (1.3%) serum agar with saccharose and lyzed blood, as well as on semiliquid (0.3%) agar. These cultures, when viewed under a phase-contrast microscope, consisted of granular, shapeless conglomerates, spheroplast-like elements and filamented structures (Figure 1b). In the other 38 primary cultures obtained from plating guinea pig organs, growth of extraneous microflora was observed when plated on solid media, and they were not submitted to any further study.

We identified the cultures by the immunofluorescent method using specific fluorescent serum and the IHAT with *Y. pestis* erythrocytic diagnosticum.

Fluorescent plague serum was used in a working dilution of 1:8. This preparation stained bacterial and L forms of *Y. pestis* intensely, but not cultures of *P. pseudotuberculosis*, *Y. enterocolitica*, *P. multocida* and *E. coli* (Table 2).

When we examined suspect samples using fluorescent serum, L forms of *Y. pestis* were found in 19 cases. Smears showed specific fluorescence of elements of L forms of bacteria, which consisted mainly of individual round spheres differing in size (Figure 2). The maximum number of positive tests was obtained in guinea pigs dissected 10-20 days after infection. After 1 month, a few cultures were isolated only from animals infected with strains 1178-L, 1589-L and 197-L.

In order to confirm the findings of this experiment, additional studies using the IHAT were pursued with species-specific antitoxic *Y. pestis* erythrocytic diagnosticum. In order to extract antigen from cultures in semiliquid agar, the samples were frozen 4 times at a temperature of  $-20^{\circ}\text{C}$  and thawed in an incubator. The samples were then centrifuged at 4000 r/min for 15 min, and the supernatant was used as antigen. The results of these studies are listed in Table 2. The obtained data coincided in essence with the results of identification using the immunofluorescent method: specific antigen--murine *P. pestis* toxin was found in the same samples and at the same times as with fluorescence microscopy (see Table 2). However, the results did not coincide in five cases. Thus, the fluorescence method showed 13 positive results in animals infected with cultures of 1178, 1762, 1591 and 282, whereas only 8 were found with the IHAT. This discrepancy could be attributed to a difference in sensitivity of the methods.

Concurrent performance of IHAT using commercial *P. pestis* antibody erythrocytic diagnosticum yielded negative results in all cases.

#### Conclusions

1. L forms of *Y. pestis* are capable of persisting in guinea pigs submitted to intraperitoneal infection for 20-30 days (duration of observation period).
2. When submitted to prolonged passages on media with osmotic stabilizer and penicillin, L forms of *Y. pestis* lose the capacity to synthesize species-specific capsular antigen FI.
3. It was shown that fluorescent serum and *Y. pestis* erythrocytic antibody diagnosticum can be used to identify L forms of *Y. pestis* in cultures of material taken from organs of experimental animals.

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UDC: 579.253.086.3

#### MEANS OF FORMATION OF ELEMENTARY BODIES AND THEIR ELIMINATION FROM CELLS OF L FORMS OF BACTERIA

[Article by N. D. Konstantinova, L. N. Kats and S. V. Prozorovskiy, Institute of Epidemiology and Microbiology imeni Gamaleya, USSR Academy of Medical Sciences, Moscow, No 1, 1982 (manuscript received 15 Dec 80) pp 44-48]

[Text] Formally, cells 0.24 to 0.5  $\mu$ m in size should be classified as elementary corpuscles; they are the minimal reproductive elements of L forms and apparently the main form in which they persist in the cell [15, 17, 19]. We previously reported the existence of several types of elementary bodies differing in submicroscopic structure, only a few of which were potentially viable and, consequently, could play a role in reproduction of L forms [7].

Our objective here was to use different methods of electron microscopy to study the means of production of elementary bodies and their elimination from the cell.\*

#### Material and Methods

In this work we used cultures of stable and unstable L forms of *Proteus vulgaris* [2], *B. subtilis* [11, 12], stable L forms of *Listeria monocytogenes* [8, 9], *S. pyogenes*, *S. aureus* [6] and unstable L forms of *Brucella abortus* [13], *Vibrio NAG* [6] (cultivation conditions for these L forms are described in the cited references).

We used the method of ultrafine sections, freezing-chipping and scanning electron microscopy. For use of the ultrafine section method, cells were fixed in 2.5% glutaraldehyde on 0.15 M phosphate buffer, pH 7.2, with 0.5 M saccharose and 0.01 M  $MgCl_2$  for 3 min, then 0.1%  $OsO_4$  on the same buffer

\*We wish to express our appreciation to Prof A. F. Bykovskiy for his valuable advice when we discussed this article.

for 18 h at room temperature; they were dehydrated in alcohols and embedded in araldite (Serva or Schuchart). Ultrafine sections were prepared on a III-LKB-8800 ultratome and contrasted with uranylacetate. The preparations were viewed and photographed using a JEM-100B microscope at instrument magnification of 30,000 and 50,000 $\times$ , and accelerating force of 80 kV.

For freezing and chipping, cells of L forms of *B. subtilis* were frozen in liquid freon cooled in liquid nitrogen without prior fixation, with 20% glycerin used as a cryoprotective agent, by a previously described method [14]. Microscopy conditions were the same.

For scanning electron microscopy, the cells were fixed as described above, dehydrated in alcohols, air-dried and powdered with carbon and platinum by circular dusting on a revolving table. The specimens were photographed under a JSM-50A scanning electron microscope with instrument magnification of 200 to 30,000 $\times$ .

## Results and Discussion

It was previously noted that the elementary bodies can divide binarily [10]. Elementary body division can take place both within and without the maternal cell. Sometimes they divide within a vacuole. However, this is obviously not the principal route of production of elementary bodies. Mass production of elementary bodies is observed in so-called spherical and large bodies, i.e., typical elements of the L population. But there can be different means of formation of elementary bodies. Thus, they can be formed both on the cell surface by means of gemmation, or within the cell in the cytoplasm or perinuclear region.

One can track formation of elementary bodies on the cell surface particularly well by scanning electron microscopy, which yields a three-dimensional image of the object Figure 1, a and b [Figures 1, 2, 3, 5 (photos) are not reproduced]. Production of elementary bodies can take place in cells that undergo binary division, and the elementary bodies could remain connected to maternal cells by anastomoses for a certain time (see Figure 1b). Scanning electron microscopy shows formation of elementary bodies within the cell also if the cell has undergone partial lysis (Figure 1c). However, this method does not permit viewing the internal structure of elementary bodies.

One can see formation of elementary bodies with use of the freezing-chipping method or freezing followed by priming. In this case, we are not only able to study a particular means of formation of elementary bodies, but to assess the structure of surfaces of a chip of elementary body membrane, i.e., internal structure of the membrane (Figure 1d).

Finally, with the method of ultrafine sections we can obtain the most complete information about the internal structure of elementary bodies that are formed by different means, as well as their relations to the maternal cell. Thus, with this method, we observed different stages of successive formation of elementary bodies by means of gemmation (Figure 2, a, b, c, d, e). In elementary bodies formed by gemmation, the cytoplasmic membrane usually has a three-layer structure (see Figure 2, a, b, d, e), although with this fixing method such a membrane structure is not demonstrable in all elementary

bodies (see Figure 2c). Some elementary bodies have a morphologically pronounced nucleoid (see Figure 2, c, d).

If the elementary bodies are formed within the cell, they could be found among the granular component of cytoplasm alone, in pairs or groups (Figure 3, a and b). Their formation starts with consolidation of a segment of cytoplasm, around which an empty space first forms and then a small vacuole that is not circumscribed by a membrane (Figure 3b). At this stage, a three-layer membrane structure is not demonstrable in most elementary bodies with the fixing method we used. More often there are also no morphologically marked nucleoids. Occasionally, there is a large group of elementary bodies and vesicles wanting in cytoplasmic contents within a vacuole contained in a membrane (Figure 3c). It is possible for the elementary bodies formed in the cytoplasm to be released from the cell, not only upon its lysis, but through small defects in the cytoplasmic membrane, formation of which is not associated with loss of viability of the maternal cell (see Figure 3, b, c). In this case, the elementary bodies retain for some time a connection to the maternal cell, in close contact with its surface or even by being connected to it by some sort of material (Figure 3d).

Finally, elementary bodies can be formed from segments of cytoplasm surrounded by myelinoid structures (see Figure 3a).

Figure 4 illustrates schematically the possible means of formation of elementary bodies and their release from the cell. These means are as follows:

1. The elementary bodies are formed by germination on the cell surface. With the fixing method used, their cytoplasmic membrane presents a distinct three-layer structure and we have arbitrarily called it complete. Conversely, when no three-layer structure membrane is demonstrable, we have used the conventional designation of "forming membrane" (see Figure 4, type 1; Figure 2, a, b, c, d, e). It should be noted that when the L forms were recovered from Gram-negative bacteria, for example, *Proteus vulgaris* and *Vibrio NAG*, and the maternal cell is of the spheroplast type, i.e., it has a cell wall membrane and cytoplasmic membrane, the elementary bodies also have two membranes.
2. Solitary elementary bodies are formed from consolidated segments of cytoplasm. Subsequently, a rarefied space appears around them and, occasionally, a membrane is formed (see Figure 4, type 2; Figure 3a; Figure 3c on the right). Elementary bodies formed in this way are apparently discharged from the cell through small breaks in the maternal cell membrane. The three-layer membrane structure is usually not demonstrable so long as the elementary bodies are in the cytoplasm. When discharged from the cell, most elementary bodies have a three-layer membrane.
3. Formation of one or many elementary bodies in a maternal cell vacuole (see Figure 4, type 3; Figure 3c in the middle). Elementary bodies are released from the cell as a result of its destruction or thinning of vacuole wall (see Figure 3b on the top left and Figure 5d). Perhaps this means of formation of elementary bodies is the final stage of the preceding means.

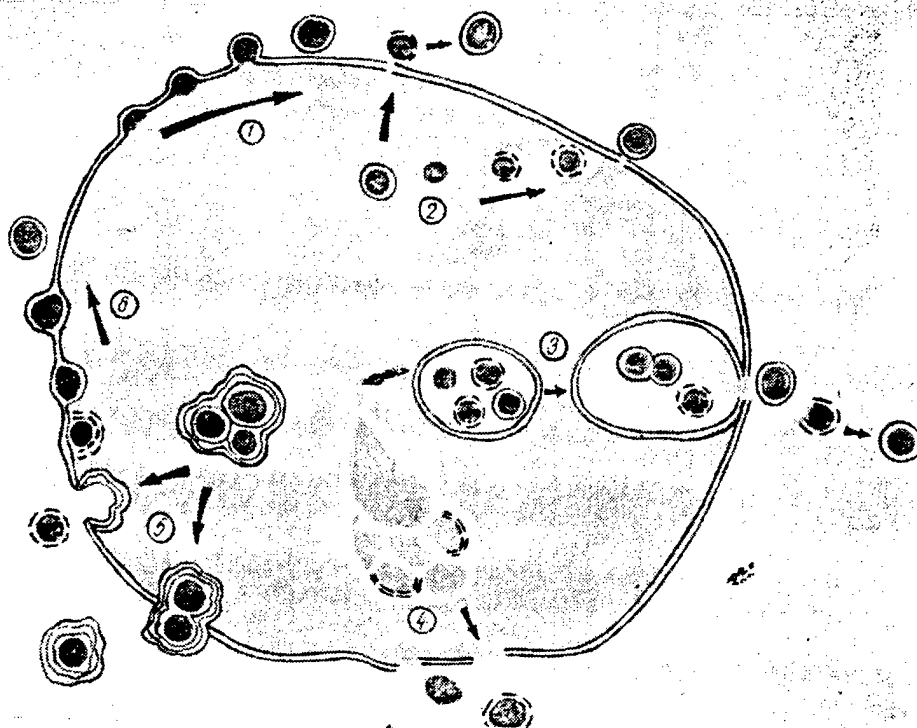


Figure 4. Formation of elementary bodies and their release from cells of L forms of bacteria (hypothetical drawing). Circle--elementary body; dotted line--forming membrane; solid line--complete membrane; wavy line--myelinoid structure. Arabic numerals indicate types of formation of elementary bodies and their discharge from the cell (explanation given in the text).

4. Formation of elementary bodies as a result of cytoplasmic "splitting" (see Figure 4, type 4; Figure 5, a and b). Elementary bodies formed in this manner are released into the surrounding medium as a result of lysis of the maternal cell, and they may or may not demonstrate a three-layer membrane structure. This process is typical mostly of early and, perhaps, late stages of L transformation.

5. Formation of elementary bodies from cytoplasm segments surrounded by myelinoid structures (see Figure 4, type 5; Figure 3a). The elementary bodies are sometimes "driven" out of the cell by the myelinoid structures that surround them. For this reason, they can be seen outside the cell, together with myelinoid structures.

6. Separation of peripheral segment from the rest of the cytoplasm as a result of ingrowth of membrane between them (see Figure 4, type 6; Figure 4c).

The capacity to form elementary bodies is one of the inherent properties of both L forms and mycoplasma. Interestingly, an analogous phenomenon has

been described in protoplasts and spheroplasts, as well as so-called L-like mutants of *E. coli*, where it is referred to as internal and external gemmation [1]. Nevertheless, the role of elementary bodies as minimal reproductive elements of a culture can be considered proven only for L forms of bacteria and mycoplasma [15, 17].

Analysis of the data about possible means of formation of elementary bodies in L forms of bacteria leads us to conclude that they can be formed on the surface and inside large bodies [5, 15-18], on the surface and within cells in spheroid bodies [4, 20], as well as on the surface of filamented structures [3]. In other words, it has been shown by different methods of electron microscopy that elementary bodies are formed in all types of cells inherent in L cultures, both on the surface and within the cell. However, the opinion is also held that formation of elementary bodies within a cell is an artifact of electron microscopy, as a result of which tortuosities on the cell surface are taken for elementary bodies [21, 22]. This opinion is not upheld by other researchers, and we consider it unlikely in the light of the submitted data.

The way in which elementary bodies are released from the cell is also interesting. The opinion has been advanced that elementary bodies are discharged into the surrounding medium upon lysis of large bodies or accidental injury to their membrane [15]. With use of the method of scanning electron microscopy and freezing-chipping, we repeatedly observed discharge of elementary bodies through large orifices in the membrane, in both spheroid cells and large bodies [3-5]. Such openings are indeed typical of lysed cells. However, one could also think that release of individual elementary bodies can also occur through small, temporarily formed defects in the cytoplasmic membrane, in the presence of which viability of the maternal cell is retained. It is unlikely that such defects could be seen on ultrafine sections, considering the plastic liquid-mosaic structure of biological membranes. Nevertheless, the close contact or even connection between many elementary bodies and the surface of nonlyzed maternal cells is indirect proof of the validity of the hypothesis we have expounded.

### Conclusions

1. Elementary bodies are formed on the surface and within all types of cells typical of L forms.
2. The following means of formation of elementary bodies have been described: on the cell surface by gemmation, right in the cytoplasm in its granular component or a vacuole, as a result of "splitting" of cytoplasm associated with destruction of the cell, as well as by separation of a peripheral segment of the cytoplasm by a membrane.
3. Release of elementary bodies from the cells occurs as a result of destruction and death of the maternal cell, thinning of the wall of a vacuole containing elementary bodies and, perhaps, through temporary small membrane defects that are not associated with destruction of the maternal cell.

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#### ISOLATION OF L FORMS OF Y. PESTIS FROM WILD RODENTS IN AN ENDEMIC SITE

[Article\* by G. S. Dunayev, L. F. Zykin, I. I. Cherchenko, L. N. Klassovskiy, S. V. Prozorovskiy, V. N. Metlin, V. S. Rybkin, V. Ya. Kurilov, V. M. Kostyukovskiy, S. R. Sayamov, M. Ya. Kulakov, S. I. Zhukova, S. I. Volosivets, P. N. Sokolov, V. A. Burdelov, Ye. R. Val'kova and A. F. Melekhina, Volgograd Scientific Research Institute for Plague Control, Alma-Ata, Institute of Epidemiology and Microbiology imeni Gamaleya, USSR Academy of Medical Sciences, Moscow, No 8, 1982 (signed to press 13 Jan 82) pp 50-54]

[Text] There are many proponents of the hypothesis to the effect that atypical strains of Y. pestis could play an important part in maintaining epizootics, as well as in the infectious process. Zabolotnyy [3] had already written that presence of spheroid forms is just as typical of old plague buboes as detection of bipolar forms in acute cases. There are reports of consistent demonstration of spheroid elements in organs of the great gerbil, as well as its fleas [5, 6, 9, 10], and authors view them as spheroplasts.

Since we developed in our previous studies the methods for cultivating L forms of Y. pestis and means of identifying them [1, 2, 4], favorable conditions were created to try to isolate L forms from wild rodents in an endemic plague site. The studies were pursued in 1979-1980 within the limits of one of the regions (Southern Lake Balkhash area) of a Central Asian site endemic for plague, where there had been an acute epizootic among great gerbils in the spring of 1979 after a 4-year interval.

In all, we examined 345 great gerbils, 10 jerboas and 5 Tolay hares. All of the rodents were caught in a permanent section of the Bakanasskiy Plague Control Department of the Taldy-Kurgan Plague Control Station.

#### Material and Methods

To isolate L forms of Y. pestis, we made cultures of the viscera of wild rodents on the medium for L forms: 0.3% semiliquid agar based on bovine myocardial digest, which contained 10% normal horse serum (NHS) without

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preservative and 15% saccharose as stabilizer. There was no penicillin, lysozyme or other factors instrumental in L transformation in the medium.

Test tubes with cultures were incubated at 28°C for 10-15 days. Concurrently, we made cultures of material on 2 and 0.3% Hottinger agar with sodium sulfite, but without serum and stabilizers, to isolate the usual bacterial forms. The initially isolated L forms were identified by means of the direct hemagglutination test (DHAT) and method of fluorescent antibodies (FAM). We studied cell morphology using an electron microscope. Definitive identification of the cultures was made after their reversion to bacillary form in the course of transfers to semiliquid or semisolid media.

As antigen for the DHAT we used a culture that had grown on semiliquid agar and been submitted to 3-fold freezing at -10°C and thawing. For this purpose, 0.5 ml semiliquid agar with primary growth was added to 2 ml NaCl physiological solution with 4% formalin; after 3-fold freezing and thawing, the suspension was inactivated at 56°C for 30 min, adsorbed with sheep erythrocytes, centrifuged at 1500 r/min for 10 min, and the supernatant was used in the DHAT. We used commercial *Y. pestis* antibody erythrocytic diagnosticum from the Central Asian Plague Control Institute, as well as experimental samples of *Y. pestis* antibody erythrocytic diagnosticum which had proven itself for detection of L forms. For the FAM, we used commercial *Y. pestis* fluorescent serum from the "Mikrob" Institute, as well as experimental specimens of fluorescent serum to the L forms we recovered [7, 8].

For electron microscopy, the cultures were fixed using a two-stage method, with 2% glutaric aldehyde and 1% osmic acid. After dehydration with ethyl alcohol, the material was imbedded in ERL-4206 epoxy resin. Ultrafine sections were prepared with an LKB-8800 ultratome. The preparations were stained with a combination of uranylacetate and lead citrate. They were examined under a JEM-100S electron microscope at instrument magnification of 10,000-100,000x.

## Results and Discussion

Examination of the 345 great gerbils resulted in isolation of 8 bacterial and 19 L forms of *Y. pestis*. No cultures were isolated from the jerboas and hares. We were impressed by the fact that the usual *Y. pestis* strains were isolated on both Hottinger agar and medium for L forms, whereas L forms were isolated only on 0.3% semiliquid agar with NHS and saccharose. Individual grayish-white colonies 0.5-1 mm in diameter grew in the column of semiliquid agar; occasionally there was diffuse growth with formation of a mucous film on the surface of the medium. Under a phase-contrast microscope, such colonies were represented by various structural elements: small corpuscles and spheroplastoid structures (Figure 1 [none of figures is reproduced]). The cultural and morphological features enabled us to tentatively identify the isolated microorganisms as forms with unbalanced growth and unstable cultures of L forms, which had been identified in the DHAT and FAM as *Y. pestis* cultures. Under a fluorescence microscope, the structural elements of L colonies stained with homologous fluorescent serum showed specific bright green fluorescence (Figure 2).

It is difficult to interpret the results because the isolated cultures were not homogeneous in biological features, representing the pathogen of plague at different stages of the process of L transformation. Three groups of cultures could be distinguished quite well among the 19 isolated strains.

We should refer to the first group strains Nos 18, 23, 2108 and 305 with unbalanced growth, the structure of whose colonies was characterized by presence of individual bacterial cells, spheroplasts and filamented elements. We rarely encountered granular and large spheroid forms. Although these cultures did not grow upon initial inoculation on bacterial medium and were slow in forming colonies when inoculated on L medium (11th-15th day of incubation), they were characterized by faster subsequent reversion into bacterial forms of *Y. pestis* (3 strains reverted entirely in the 2d passage and 1 in the 3d).

The second group consisted of strains Nos 29, 48, 53, 67, 606, 534, 513, 145 and 303, which can be interpreted as unstable cultures of L forms of *Y. pestis*. Upon initial inoculation, colonies were formed on the 10th-15th day only on L medium; they consisted of spheroid and granular forms, with no rod-like forms. Electron microscopy revealed small circular internal membranes in these cultures, which are often encountered in the cytoplasm of L forms of bacteria. The positive results of the DHAT with experimental series of antibody erythrocytic diagnosticum and negative ones with commercial diagnosticum were an indirect indication of absence of specific F1 capsular antigen in these cultures. Fluorescent granular conglomerates and spheroid elements were found in smears of these strains which were stained with fluorescent *Y. pestis* serum. The reversion process was complete by the 3d-4th passage when Hottinger agar was used.

Electron microscopy of this group of cultures revealed many cells of the spheroplast type 1-1.5  $\mu$ m in size, with markedly dilated periplasmic space. We also found cellular elements 0.3-0.8  $\mu$ m in size circumscribed by one or two membranes. They contained internal structures, which can apparently be viewed as elementary bodies that provide for L-form reproduction.

Large cells (more than 2  $\mu$ m) of the protoplast type were found in isolated cases, whereas bacterial cells with unchanged ultrastructure were absent. We found a considerable quantity of elements with signs of development of a system of internal membranes. In the cytoplasm of such cells and surrounding medium, there were many circular membrane structures, sometimes connected to the residue of the cell wall (Figure 3). This fact indicates that, concurrently with development of internal membranes, there is also discharge thereof. A special type of division (Figure 4) is also inherent in L forms of the spheroplast type.

Thus, electron microscopy of cultures isolated from great gerbils revealed morphological elements typical of the process of L transformation: cells of the spheroplast and protoplast types, numerous circular membranes, special type of division, in which daughter cells remain invested in the same membrane.

Another group of cultures (Nos 30, 85, 205, 292, 412, 418) perished in the course of passages after formation of colonies in the initial culture on

L medium. Such a phenomenon is typical of both unstable and stable cultures of bacterial L forms when isolated from the body or tissue cultures, and they could be the consequence of absence of a set of nutrient needs, which have not yet been determined, from the L medium we used. Morphologically, this group of cultures consisted of colonies containing spheroid, granular and, less often, filamented forms. The results of initial immunofluorescent identification and DHAT justified our classification of these cultures as *Y. pestis*.

Thirteen revertant cultures from forms with unbalanced growth and unstable cultures of L forms of *Y. pestis* differed in a number of signs from the strains that circulate among great gerbils in this region. On Hottinger agar, most cultures grew in the form of smooth and uneven colonies without a peripheral zone. On the 2d day, they formed marked clouding on the broth and later a superficial film. Phase-contrast microscopy revealed not only bacillary, but round and dumb-bell-shaped elements. The revertants fermented glucose, maltose, mannitose, did not decompose saccharose, lactose, arabinose, and showed no urease activity. There was slow fermentation of glycerin (7th-15th day). Strains Nos 18, 23, 29, 48, 53, 67 and 2108 were pestiginogenic, synthesized capsular antigen Fl, murine toxin and the basic somatic antigen. Virulence of revertants (1 DCL) constituted  $1 \cdot 10^4$ - $1 \cdot 10^5$  for white mice and  $1 \cdot 10^4$ - $1 \cdot 10^7$  for guinea pigs.

Thus, our examination of great gerbils yielded cultures which did not grow on the usual media at the time they were isolated, but only on media for L forms; they developed slowly, forming small colonies in a column of semiliquid agar, which consisted of elements that are typical of the process of L transformation. Serological techniques proved that these cultures were referable to *Y. pestis*; when submitted to reinoculation, most of the isolated strains underwent reversion into the bacillary forms. All this enables us to identify the isolated strains as forms of unbalanced growth and unstable L forms of *Y. pestis*. The properties of these cultures were very similar to L forms and *Y. pestis* revertants that we obtained previously under experimental conditions, although there were some differences [1, 2]. Our findings indicate that the methodological procedures we developed are quite suitable for isolation and identification of forms of unbalanced growth and unstable cultures of L forms of *Y. pestis* from wild rodents in an endemic site.

### Conclusions

1. In 1979-1980, 19 strains were isolated from great gerbils in Southern Balkhash, which were identified as forms of unbalanced growth and unstable cultures of L forms of *Y. pestis*.
2. These cultures, which were isolated on a special medium, were represented by fine-grain, spheroplastoid, filamented elements, which showed specific fluorescence when stained with fluorescent serum and a positive DHAT. Circular internal membranes were found in some cultures under an electron microscope.
3. Thirteen cultures reverted to the bacillary form when recultured, six strains were not recultured.

4. A technique was refined for isolation and identification of forms of unbalanced growth and unstable cultures of L forms of *Y. pestis* from wild rodents.

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## LASER EFFECTS

### LIGHT PENETRATION OF OPAQUE PHYSICAL AND BIOLOGICAL MEDIUMS USING COMPRESSION

Moscow PRIRODA in Russian No 5, May 83 pp 72-78

[Article by Gurgen Ashotovich Askar'yan, senior scientist at the Physics Institute imeni P. N. Lebedev of the USSR Academy of Sciences; specialist in quantum electronics, nonlinear optics, plasma physics, and nuclear physics; discovered the self-focusing effect of electromagnetic, light, and sound waves (1962); contributed to the discovery of the light-hydraulic effect (1963); author of the first studies on coronal nonlinear light diffusion, the acoustic effects in the movement of charged particles, strong non-collision excitation of molecules, self-acceleration of charged particles in gases, radio emissions from cosmic particle showers, and others; winner of the UkSSR State Prize (1971).]

[Text] In solving various problems in physics, biology, medicine, and technology, it is necessary to pass some kind of radiation, light in particular, through opaque (that is, diffusion and absorbing) mediums<sup>1</sup>. This is done, for example, in radioscopy, irradiation of the human body, light penetration, and transmission of light energy. It is often the case that significant weakening of the radiation hinders successful resolution of the problem at hand.

One of the interesting applications of laser irradiation in medicine and biology which has emerged recently is its capacity to stimulate regenerative and immune processes in an organism's cells and tissues. This is apparently tied to the resonant nature of the absorption. For example, one of the absorption bands in a tissue is close to the wave length generated by the helium-neon laser--0.63 micron. The use of these lasers in the treatment of burns, trophic ulcers, wounds that won't heal, stomatitides, polyneuritis, and other pathological processes that involve the organism's surface tissues, is well known<sup>2</sup>. The action of ultraviolet rays with strong therapeutic effects is also significant (for example, irradiation by nitrogen laser, harmonics of laser rays, and so on). All these types of irradiation, however, offer only shallow penetration (for example,  $z \sim 1-2\text{mm}$  for red light) due to the strong diffusion and absorption in biological tissues; thus they cannot be used for deep irradiation.

If we are interested in a depth  $z \gg z_s$  (at a depth  $z_s$  the irradiation is weaker by a factor of  $e$ ), then even a small<sup>s</sup> change in  $z_s$  can result in a significant

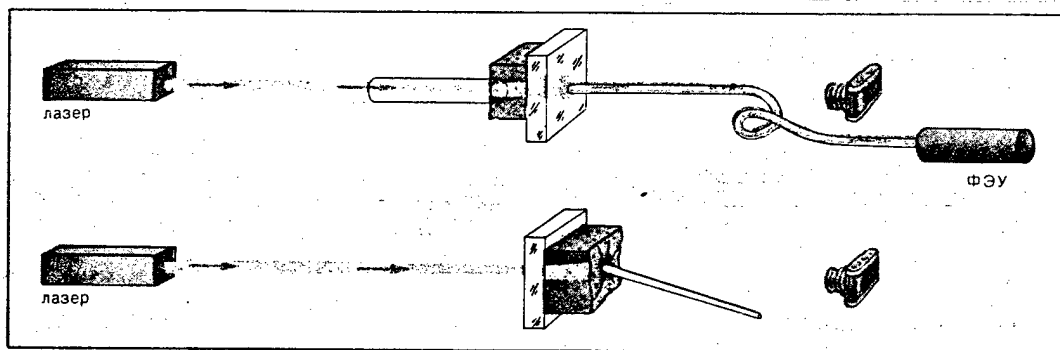
change in the intensity of the light  $I$  due to the strong relationship  $I(z_s)$ ; for example,  $I \sim \exp(-z/z_s)$  or  $I \sim (z/z_s)^k$ .

In all problems involving the passage of light through opaque mediums, in the past no consideration has been given to the possibility of compressing the mediums. It turns out that compression of a medium has a strong effect on the way in which irradiation passes through it.

Research that we conducted at the Physics Institute imeni P. N. Lebedev of the USSR Academy of Sciences<sup>3</sup> showed that it is possible to increase sharply the intensity of the light passing through, and thus also increase its therapeutic effect on tissues and mediums lying much deeper than the depth of penetration achieved without compression. We studied the penetration of laser irradiation at great depths and the increase in its penetration with uniformly distributed or local compression (pressure) and puncturing of a layer of the opaque, compressed medium.

#### Increased Transparency with Compression of a Physical Medium

As models of an opaque medium we used a layer of porolon and a ream of paper with adjustable air spaces between the sheets. Pressure was generated by a transparent cylinder (a stick made of plexiglas or glass), a tube, or the end of the light transmitter. In the control experiment, uniform pressure was exerted on the porolon by placing it between two glass plates, the cross-section of which was much greater than the thickness of the porolon layer. The light source was a continuous helium-neon laser LG-75, with a light capacity of 15-20 milliwatts. The layer was placed on a secured glass plate and was pressed between it and a cylinder. The thickness of the locally compressed layer was measured as the distance between the end of the cylinder touching the layer and the glass plate.

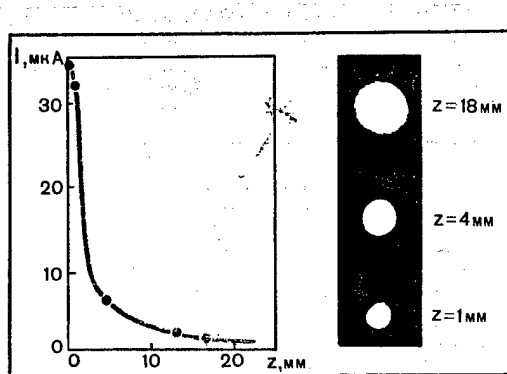


Model of the experiment. The top figure shows compression on the side at which the light enters; the lower figure shows compression on the exit side.

The spot of diffused light leaving the layer was recorded by a camera. The intensity of the irradiation at the center of the spot was measured by a photomultiplier; the irradiation reached the cathode in the photomultiplier through a light transmitter with an internal diameter of 2 mm, or through an opening with a diameter of 1 mm in the end of the photomultiplier case,

attached directly to the plate. Absolute calibration of the weakening of the light was done by comparing it to the absorption in a ream of standard filters.

When porolon with an original thickness of  $z_0=22$  mm was compressed to  $z=2$  mm, there was a sharp increase in the signal; the intensity measured at the center of the spot increased by a factor of more than 30. The intensity depended on the thickness of the layer according to the law  $I \sim z^{-\alpha}$ , where  $\alpha=1; 2$ .



Increase in the intensity of laser irradiation (current of photomultiplier 1), diffused by the layer of porolon with an initial thickness of  $z_0=22$  mm. On the right are photographs of the spot of diffused light with varying thickness in the compressed layer. The diameter of the smallest bright spot is 15 mm; a plexiglas cylinder 10 mm in diameter was used to compress the layer. The exposure was at 1/500 with film speed of 40 units according to the All-Union State Standard.

#### Possible Mechanisms of the Effect of Increased Light Penetration with a Compressed Physical Medium

What are the reasons for light penetration of opaque physical mediums that occurs with compression? There are several possible explanations. We will present those that are the simplest and most important in our discussion.

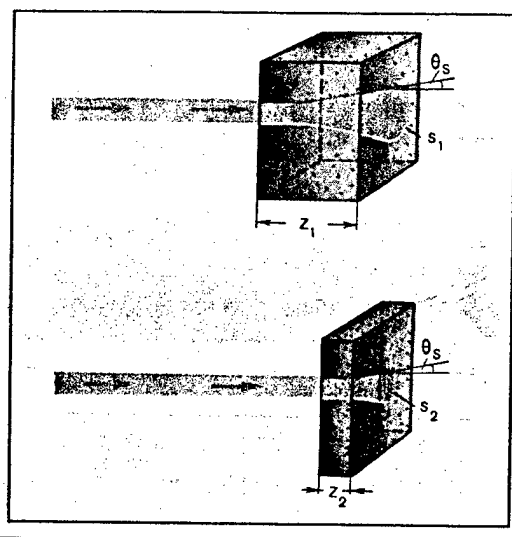
First, we will assume that the compression of a layer of a diffusion medium is a flat plane, that is, it does not change the quantity of the substance in the layer in the path of the light (accordingly, the number of diffusion centers in the layer remains constant,  $nz=\text{const}$ , where  $n$  is the concentration of diffusion centers in the substance). Passing through a layer of the substance, the light undergoes multiple diffusion. The total angle of diffusion (under the condition that it is small), can be defined by the approximate equality:

$$\theta_s^2 \approx \theta_1^2 \sigma n z \sim z/z_s,$$

where  $\sigma$  is the cross-section of diffusion at one center;  $\theta_1$  is the mean effective angle for one act of diffusion;  $z_s$  is the length of strong diffusion (see below). We assume that diffusion at the different centers is independent, that is, the distance between them is much greater than the wave length of the incident irradiation which usually takes place. It is clear from the relationship presented that  $\theta_s^2$  is proportional to  $nz$ , and thus if  $nz$  is



constant,  $\theta_s^2$  does not change either. The area of the spot of diffused light with a small angle  $\theta_s$  is approximately equal to  $(z\theta_s)^2$ ; that is, it is proportional to the square of the thickness of the layer,  $z^2$ . Therefore the intensity at the center of the spot is inversely proportional to the area of the spot and must increase as the layer is compressed, according to the law  $1/z^2$ .



An increase in light penetration occurs when a layer of diffusion medium is compressed due to a "geometric" effect: the intensity of the light  $I$  upon exit from the layer is inversely proportional to the area of the illuminated spot on the back surface of the layer  $s$ . In turn, this area is determined by the thickness of layer  $z$  and the total angle of multiple diffusion  $\theta_s$ , which in both cases is approximately the same, since the number of diffusion centers does not change with compression. Thus we have  $I_2/I_1 \sim s_1/s_2 \sim z_1^2/z_2^2$ .

Even with small angles  $\theta_s^2$  and small initial radii of the beam's cross-section, the diffusion can be strong; that is, the area of the spot  $s$  of diffused light will be much greater than the area  $s_0$  of the original spot:  $s \sim (z\theta_s)^2 \gg s_0$ . This occurs when  $z \gg (s_0 z_0)^{1/3}$ . Diffusion will be very strong when the angles of diffusion become large  $\theta_s^2 \sim z/z_0 \gg 1$  where  $z \gg z_0$ ; that is, the irradiation completely loses its directedness. In this case, the distribution of the light will be diffuse.

For large angles of diffusion, when  $z \gg z_0$ , the improved light penetration can be explained by a decrease in the diffusion of light in the direction perpendicular to its distribution. In this case, one can see that the area of the spot of diffused light is also proportional to the square of the thickness of the layer  $z^2$ . Indeed, with this diffusion the flow density of  $J$  quanta through the surface of a sphere with a radius  $R$  is defined by the power  $P$  of the light source in the center of the sphere--the light's point of incidence:  $J = P/4\pi R^2$ . Directly from this we can obtain a projection of the flow onto an ideally chosen plane at a depth  $z$ :

$$J_{\perp}(z) = J \cos \theta (P/4\pi R^2) z/R.$$

Since  $R = \sqrt{Q^2 + z^2}$ , where  $Q$  is the distance from the axis of the light beam, then when  $Q \ll z$ , we have

$$J_{\perp}(z) = Pz / (Q^2 + z^2)^{3/2} \sim 1/z^2;$$

that is,  $J$  is not dependent on the diffusion properties and is determined only by the thickness of the layer  $z$ . The distance from the axis of the beam, where the intensity drops to one-half the original level,  $\Delta Q \sim z$ , is a value that determines the resolution of the image; that is, with a decrease in the thickness of the layer, the clarity of the image increases.

Limiting conditions on the surface were not taken into account in these estimated calculations.

Other mechanisms of increased light penetration are also possible. For example, the compression of a substance can even lead to the distance between diffusion centers becoming much smaller than the wave length of incident light; that is, the medium will behave not as a diffusion medium, but as a macroscopically homogeneous medium and will allow more light to pass through. A change in the polarizability and the orientation of the diffusion centers caused by compression can also have an effect on light penetrability.

It should be noted that all the calculations presented here are of an approximate, qualitative nature. We did not take into account light absorption, the possible change in the cross-section of diffusion centers under compression, or geometrical deviations from a plane. Nonetheless, these calculations can certainly illustrate the experiment's results.

#### An Increase in Transparency Resulting from Pressure on a Layer of Biological Tissue

We also studied the change in light penetrability in human tissue. The palm was used as the diffusion layer, with a beam of helium-neon laser directed onto the center of the palm. The thickness of the center of the palm was 2.7 cm, and with weak compression (up to a mild sensation of pain) it was 2 cm. When light was directed onto the back side of the palm and a glass rod was used to press against the inside of the palm, there was a sharp rise in light penetrability. When a plexiglas cylinder, along which light was transmitted, was pressed against the palm, there was also a sharp increase in the intensity of the light.

The size of the effect was measured by a photomultiplier. The back of the hand covered an opening in the end of the photomultiplier case, right in front of the photocathode.

In this manner we determined that without compression approximately  $10^{-6}$  of the incident power passed through the palm. With a palm thickness of  $z_0 = 2.7$  cm, this weakening ( $10^{-6} \approx e^{-14.4} \approx \exp(-z/z_0)$ ) corresponds to a depth of penetration of  $z \approx 2$  mm for an average tissue density in this part of the palm; this coincides with data found in the literature. The thicker parts of the palm--the areas along the edge and near the phalanges--are more penetrable to light, and are more susceptible to the effect under consideration, than is the central

part. The pressure of the plexiglas cylinder on the inner surface of the palm with the given value of 0.7 cm, increased the current of the photomultiplier, that is, the intensity of the light that passed through, by a factor of 40. Even greater light penetration--up to 100-fold increases--was observed with a decrease in the cylinder's diameter.

The small compression of biological tissue leads to a much greater effect than that seen with porolon apparently because of the heterogeneity of the biological tissue. It contains elements that are forced out of the compressed layer--blood is squeezed out, muscles are pushed aside (we are reminded of how a person's palms, nose, and forehead turn white when pressed against glass). It is interesting to note the relaxation of the effect: when the pressure is removed, light continues to penetrate for another 1-3 seconds. Thus, in therapeutic applications of this effect, the application of pressure and removal of pressure can be alternated. This makes it possible to combine the increased transparency with normal tissue functioning.

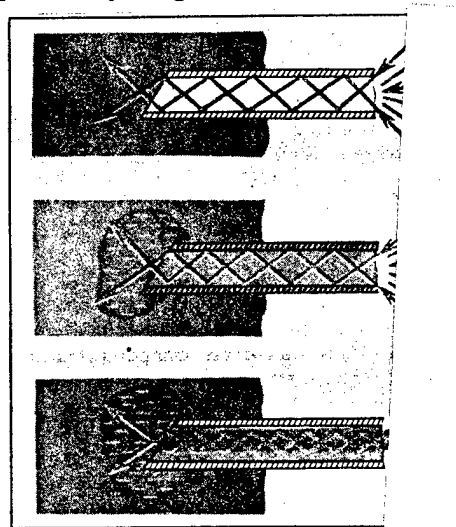


Increased transparency of the hand with compression. Exposure lasted 30 sec, an LG-75 laser was used. Left to right: the ray falls on the back side of the hand, a sharp increase in the light's intensity can be seen in the area on which the glass rod is exerting pressure; the ray falls on the inside of the palm, there is no compression, and no light passes through; the inside of the palm is pressed against a plexiglas cylinder containing a light transmitter.

It is clear from the results obtained that it is possible to apply laser irradiation for therapeutic purposes on tissue at a depth of approximately 2 cm (penetration  $< e^{-10} \approx 2 \times 10^{-4}$ ). This makes it possible to arrive at applicable therapeutic doses with judicious increases in exposure; these can be hundred-fold increases (hours of exposure rather than the minutes of exposure now being used for surface irradiation).

Transmission of Light through a Diffusion Layer by Means of punctures; the Light Syringe

When it is necessary to transmit light through a thick layer of diffusion medium, it is possible to puncture the layer with a hollow needle, through which light can be transmitted (a "light syringe"). We can propose several variations for this type of syringe.

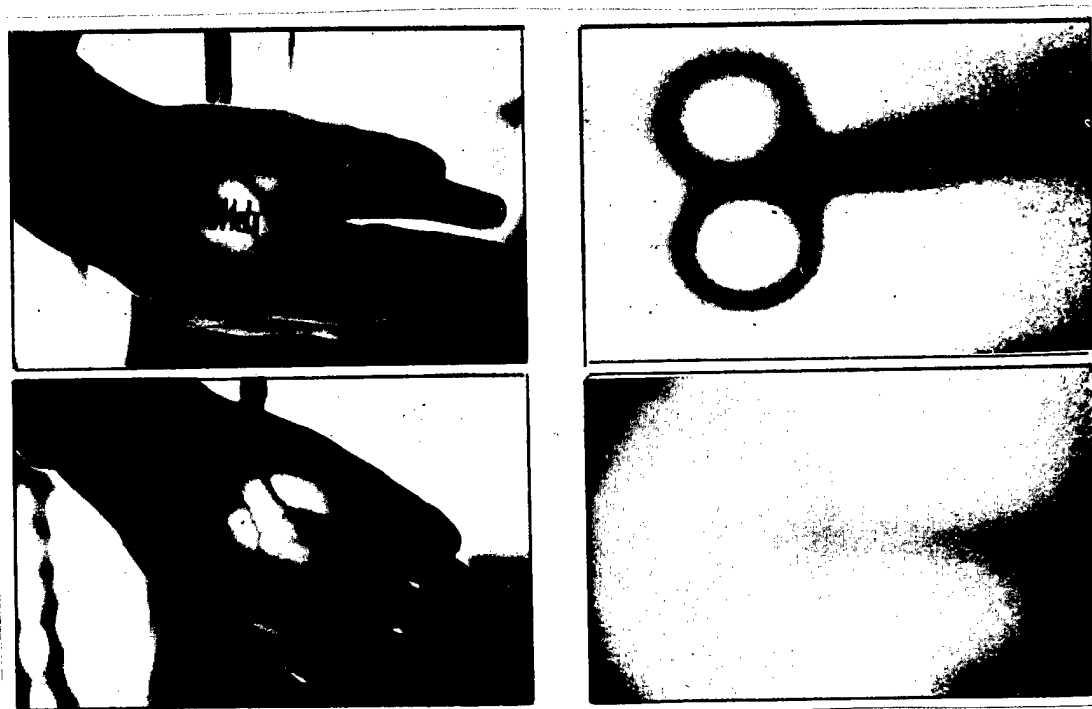


"Light syringe". From top to bottom: Light is transmitted by reflections off the inner walls of the needle; a fluid is injected which moves tissue away from the end of the needle; the needle containing the light transmitter and the fluid injection.

Light can be transmitted by reflections off the inner walls of the hollow needle. Passage of light through ordinary syringe needles was measured experimentally. Irradiation with the aid of a light transmitter was introduced by way of a 3-mm lead into a needle with an external diameter of 0.5 mm; the light passing through the needle was recorded visually on a screen or with the aid of a photomultiplier. A significant proportion of the energy that went into the channel passed through it, if the walls of the needle were shiny enough and the needle was not too long. The proportion of the energy entering the channel could be increased significantly by focusing the irradiation at the end of the channel. Rapid divergence of the light after it left the channel ( $\theta \approx 0.1-0.2$  rad) showed that the multiple reflections off the walls were important (the number of reflections was on the order of  $L\theta/a \approx 20$ , where  $L$  is the length of the channel, and  $a$  is its radius; therefore the high quality of the reflection is very important). For an ordinary channel surface (when a needle has been kept long after it was used), good light transmission was obtained only when  $L \approx 3-5$  cm and the channel radius  $a \approx 0.1$  mm.

The channel of the needle can be filled with a dielectric (in solid, liquid or gas form), the purpose of which is to prevent tissue or body fluids from entering the channel, as well as to push the edge of the tissue away from the needle puncture. The latter function can be carried out by injecting a fluid through the needle (an anesthetic, for example). This type of preliminary injection to move the tissue away from the needle puncture weakens the thermal effects that accompany high intensities of light, by allowing the light to disperse after it leaves the canal.

The effectiveness of the syringe can be increased significantly if a segment of the light conductor is inserted into the channel; the segment transports the light without allowing it to touch the metal walls of the channel. With this method, light can be transmitted practically without any loss. A fluid injection to move the tissue border aside can be done through a slit along the edge of the channel; or a double needle can be used, with one channel for the light and the other for the fluid injection.



Introscopy of a layer of porolon 21 mm thick with scissors inside. Top--no compression. Bottom--compressed to 7 mm. Exposure to a 60 watt incandescent lamp for 1/30 sec.

#### Possible Applications of this Effect

It seems that the effects we have described can open up large, yet unrealized possibilities in the therapeutic use of low intensity laser irradiation on internal organs and tissues.

What potential applications can we suggest for testing? For example, there is the possibility of applying laser therapy for treatment of neural infections of the spinal cord, such as lateral amyotrophic and diffuse sclerosis, and others. The proximity of the vertebrae to the surface; the spaces between the vertebrae, which can be increased easily by flexing the spine; and the broad indicatrix of light diffusion allow hope for the possibility of irradiating the spinal cord with deep, diffuse irradiation.

In neural infections, which cause nerve cell death, laser irradiation may increase the cells' viability, resistance, and biological activity; and in the initial stages, it is capable of slowing down and even halting the disease

process. This type of irradiation may be useful in treating many other (as yet undiscovered) mechanisms of slow infections--from viruses to contact cell interactions. In addition to the optic diffusion, "biological" diffusion is also possible--intercellular transmission of excitation and activity from irradiated cells to neighboring cells; this increases even more the effectiveness of the laser's action. Strong stimulation of cells can change the indicator of refraction and absorption in tissues' microstructural dissimilarities and can elicit<sup>4</sup> the biological analogue of the effect of transparency and self-focusing, which decreases the absorption and dispersion of the light ray. The possibility of determining the localization of disease sites according to symptoms of the illness is made easier by the laser action, both with surface irradiation and increased transparency caused by compression or puncture of the tissue layer (depending on the thickness of the tissues, which is related to the condition and age of the patient).

It would also be advisable to study the effect of irradiation on centers that regulate the immune processes with the aim of strengthening, correcting, or suppressing their activity; as well as the possible effect on controlling the aging processes. It is possible to obtain deep action with external irradiation or with a shallow injection, without introducing a probe into the cavity, when irradiating a stomach or intestinal ulcer, or in the treatment of oncological diseases.

Application of weak ultraviolet irradiation in deep tissues will make it possible to influence cellular processes or to produce a bactericidal effect on sites of pathological processes, on cerebrospinal fluid (irradiation of a liquor, for example), and so on. Of course, all these effects should be verified and studied under special conditions. Here we are speaking only of the desirability of increasing the depth of the therapeutic irradiation action.

Naturally, the effect of increased transparency with compression is also observed with noncoherent light sources--light bulbs, and so forth. Furthermore, all the above calculations and discussion remain in force and the effect should be observed for any type of irradiation--radiological, x-ray, ultrasound, ionizing particles, and so on. Indeed, compression of a layer will decrease not only the spot of diffusion of these types of irradiation, but also the absorption, because blood and tissues will be forced out of the area that is under pressure. The squeezing out of the blood should especially improve the passage of radiological irradiation: blood (like salt water) is a particularly strong absorber of radio waves. The use of a hollow needle and a puncture is particularly effective in applying ionizing irradiation, since it protects the tissues of the punctured layer from excess exposure and at the same time provides deep irradiation of the required intensity without much loss of strength. All this expands the possibilities for radiation therapy.

There is one instance, however, when increased transparency of tissues by compression or puncture can be used directly. This is introscopy, which reveals the internal structure of objects. We conducted research on the application of this effect in introscopy. The model of the experiment was as follows. The light source was a helium-neon laser with an unfocused beam, or an incandescent lamp with a reflector. It illuminated a layer of porolon which was held between two plexiglas plates. Inside the the multi-layered porolon

was an opaque object--scissors, a cross made of wire, some netting, etc. This object was not visible when the medium was not compressed. The more the layer was compressed, the clearer the outline of the object became. A camera was used to record this.

Research has also been done on introscopy of human tissue. When a palm is pressed against a plexiglas cylinder containing a light conductor, along which a helium-neon laser beam is being transmitted, veins located on the external surface of the hand were visible on the other side, as were inscriptions, and so on. With no compression, no light passed through this part of the palm (30 sec exposure). Thus, it is possible to find fragments and splinters lying not far from the surface without using x-rays.

The increase in the resolution of the structure of objects located inside layers of diffusion mediums that comes with compression, can be used not only in medicine, but in biology, technology, criminology, and so on.

This is just an incomplete list of the possible applications of the new effect.

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9967

CSO: 1840/594

LASER MICROSURGERY FOR ORGANIC PUPILLARY BLOCK

Odessa OFTAL'MOLOGICHESKIY ZHURNAL in Russian No 3, 1983 pp 160-162

[Article by P. I. Saprykin, doctor of medical sciences, and A. Yu. Kalent'yev, physician. Department of Eye Diseases, Saratov Order of the Red Banner of Labor Medical Institute.]

[Text] Organic pupillary block develops as a result of adhesion of the pupillary margin of the iris to underlying tissues. A consequence of pupillary block is disruption in intraocular fluid circulation, leading to secondary glaucoma. There is a difference between iridovitreous and iridocrystalline blocks. Taking into account the fact that the adhesion process is seldom limited to the area of the pupil, the terms iridovitreous and iridocrystalline block describe not only the anatomical character of the adjacent tissues, but also the extent of the process and, consequently, the tactics necessary for surgical intervention. Causes of these blocks are iridocyclitis, vitreous body rupture, hemorrhage into the anterior chamber and vitreous body, acute glaucoma, chronic miosis, healing over of the pupil and peripheral coloboma of the iris.

Until very recently, organic pupillary blocks were eliminated by dissecting pupillary synechiae with an instrument introduced into the eye, forming an iridal coloboma allowing resumption of intraocular fluid circulation (A. Kallakhan, 1963; M. L. Krasnov, 1976).

Known methods for treating secondary glaucoma caused by organic pupillary block are via posterior and anterior hyaloidotomy and cyclodialysis (A. P. Zabodonina, G. I. Kulzhanskaya, 1972; A. P. Nesterov et al., 1977). All of these methods for combatting organic pupillary block and iridovitreous block are by their very nature, however, usually a second or third cavity operation, fraught with such complications as hyphema, hemophthalmia, ciliochoroidal exfoliation, intraocular infection, etc.

Meyer-Schwicherath (1960) proposed the use of a xenon photocoagulator to eliminate pupillary block in aphectic eyes; later argon laser irradiation was used to eliminate iridovitreous and iridocrystalline block (Hager, 1975; Anderson et al., 1975; Schwartz et al., 1978). The authors reported that laser treatment of organic pupillary block had a positive effect.



We have at our disposal experience in treating organic pupillary block by the photocoagulation method in 35 patients, aged 22 to 75.

Domestic experimental laser equipment, assembled in the SMI [Saratov Medical Institute] Eye Diseases Clinic, which employs an LC-106M argon laser and a ShchL-56 alkaline lamp and, also, a "MIRA" (USA) MF-2000 argon laser coagulator, were used.

In 24 patients onset of organic pupillary block was due to iridocyclitis in an aphakic eye; in 11 of these patients it had developed more than a month after cataract removal. Organic pupillary block occurred in 8 patients as a result of iridocyclitis in eyes with intact crystalline lenses. Chronic miosis promoted the development of organic pupillary block in 2 patients suffering from glaucoma, and in one patient it was from intractable hyphema occurring as a result of antiglaucoma surgery. Corneal edema, unevenness and reduction in depth of the anterior chamber, bulging iris, increased intraocular pressure and reduced visual function of 0.06-0.02 were reported in all patients.

Since superficial corneal burns occurred in a number of patients as a result of corneal edema during laser coagulation of the iris, particularly in those people who had undergone tonometry 24 hours prior to treatment, local dehydration therapy was administered in the form of an instillation of glycer and a 40% glucose solution in the conjunctival cavity before laser intervention, in order to improve corneal transparency and prevent burning.

Coagulation of pupillary synechiae (synechotomy) was performed in 17 patients with synechiae in only the pupillary margin of the iris. The following parameters were used to do this: output power of the argon laser varied from 0.45 to 0.6 Wt, exposure 0.2-0.8 seconds, diameter of the spot in the focal plane of the microscope 50-150  $\mu$ m with the incidence of the ray oblique to the axis of the eye to prevent burns to the central part of the retina. The number of applications was 30-70 per session, the number of sessions 1-3.

In all cases the synechiae were destroyed, the anterior chamber was deepened and intraocular pressure was brought down to normal levels. However, in three patients pupillary block recurred, due to exacerbation of adhesive inflammation as a consequence of an extensive burn on the surface of the iris. In order to destroy the circular pupillary synechia in these patients, the number of applications to the iris reached 100 per session. After the acute inflammatory symptoms had subsided, repeat laser intervention was necessary in the form of laser iridectomy, resulting in elimination of the pupillary block.

In 18 patients the adhesive process was not limited to the pupillary margin but was significantly more widespread; in a number of cases meridional fusion of the iris to underlying tissues with formation of several separated "posterior chambers" was noted. The configuration of the pupil, of the bulging iris and of the anterior chamber changed according to the extent of the adhesive process. Retrobulbar novocain anesthesia was administered to patients of this group before the laser intervention.

In this case treatment consisted of application of coagulations at sites of a iris according to a procedure developed by us using a refocused laser. The two-stage iridectomy procedure, with laser beam refocussing, contemplates--as the first stage (in order to coagulate newly-formed vessels in the iris and to precisely define the irradiated region)--the use of a laser with 0.45-0.6 Vt capacity, 0.5 s exposure and 250 mcm diameter of the ray in the focal plane of the microscope. As the second stage, in the center of the coagulated region of the iris--with previous capacity and exposure--there is carried out a refocussing of the ray to 50 mcm and an irradiated, with formation of a deep defect and destruction of the pigment layer, and, in a number of lasers, with creation of a penetrating [passing-through] defect in the iris (Figs. 1, 2, 3, 4). Moreover, at the moment of coagulation the pupillary margin of the iris became distended, contributing to distention and sometimes partial rupture of posterior synechiae.

Subjective perceptions of the patients were a slight pain in the eye at the moment of coagulation of the iris. The eye reacted to laser intervention with an improvement in conjunctival injection, and symptoms of mild corneal edema and an irritation.

Laser interventions were performed in all patients in conjunction with locally applied corticosteroids. Anti-inflammatory drips containing Levomycetin 0.06, riboflavin 0.002, heparin 500 units, and 0.9% sodium chloride solution 500.0, were begun immediately after the treatment session.

Immediately after coagulation 15 patients experienced deepening of the anterior chamber and a reduction in bulging of the iris and intraocular pressure, regardless of the fact that a coloboma extending through the iris had been achieved in only ten patients. Pupillary block was not successfully eliminated in 4 patients due to extensive surface adhesion of slightly pigmented irises to underlying tissues.

Among complications that should be mentioned are corneal burns in the form of whitish coin-like opacities in two patients who had undergone tonometry the day before. The opacities disappeared after two to three days. Hemorrhage from the damaged iridal vessel into the anterior chamber was noted in one patient. The hemorrhage ceased after coagulation of the vessel by a refocused laser beam. In cases where the anterior chamber is very shallow, the possibility of formation of anterior synechiae corresponding to basal iridal coagulation foci should be mentioned. A complication such as this occurred in one patient.

Partial or complete positive effect was noted as a result of laser synechotomy and iridectomy in 31 out of 35 patients: the anterior chamber was deepened, bulging of the iris was reduced or fully disappeared, ophthalmic tonicity returned to normal and visual acuity increased up to 0.1-0.6 during an observation period up to 3.5 years.

Surgical interventions were performed in four patients who did not have a positive result after laser interventions.

### Conclusions

1. Laser microinterventions (synechotomy and iridectomy) made it possible to avoid cavity surgery in the treatment of organic pupillary block in 31 of 35 patients.
2. Two-stage iridectomy with beam refocusing prevents hemorrhage from the iris and facilitates formation of a basal coloboma and elimination of pupillary block.
3. Extensive burn surface on the iris after laser interventions can promote recurrence of the adhesive process.
4. The use of laser interventions in the iris in cases of corneal edema is not very effective and is accompanied by corneal burns. In order to prevent this complication, dehydration of the cornea prior to coagulation by instilling glycerin and hypertonic glucose solution is indicated.

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12262

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EFFECT ON MYOCARDIUM OF GAS-TRANSPORTING OF EMULSIONS PERFLUOROHYDROCARBONS  
(ION TRANSPORT, CONTRACTILE ACTIVITY AND MEDIATOR SENSITIVITY)

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 270, No 2, May 83  
(manuscript received 4 Nov 82) pp 459-461

KOKOZ, Yu. M., KOBRINSKIY, Ye. M., FREYDIN, A. A., ISLAMOV, B. I.,  
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[Abstract] The action of a perfluorohydrocarbon emulsion developed by the  
Institute of Biological Physics on the function of frog auricle was studied,  
using isotonic Ringers solution as a control. Resting potential, rapid sodium  
influx and slow calcium secretion were not affected by the emulsion, while  
slow calcium influx was reversibly lessened by 40%, indicating a change in  
maximal calcium channel conductivity. Contractile strength decreased 18%,  
with the effect lasting a factor of ten longer than the change in calcium  
flux. This means that the emulsion affects the myocardial contraction  
regulatory system. Sensitivity to adrenalin and acetylcholine is not altered.  
The results obtained demonstrate that the emulsion retards the functioning of  
the membrane sodium calcium exchange system and possible sarcolemma calcium  
ATPase activity. Perfluorohydrocarbons should be useful in preventing  
arrhythmias arising from disturbances in calcium transport and protecting  
the myocardium from anoxia during heart surgery. Figures 4; references 6:

1 Russian, 5 Western.

[589-12126]

## REPLACING LARGE QUANTITIES OF BLOOD WITH GAS-TRANSPORTING SUBSTANCE BASED ON PERFLUOROHYDROCARBONS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 270, No 2, May 83  
(manuscript received 27 Nov 82) pp 487-491

BELOYARTSEV, F. F., IVANITSKIY, G. R., corresponding member, USSR Academy of Sciences, ISLAMOV, B. I., MAYEVSKIY, Ye. I., SHIBAYEV, N. V. and BRUSTOVETSKIY, N. I., Institute of Biological Physics, USSR Academy of Sciences, Pushchino, Moscow Oblast'

[Abstract] A biocompatible, gas-transporting emulsion of totally fluorinated organic compounds, developed by the Institute of Biological Physics, has been used to replace large quantities of blood in small and large animals. The emulsion also contained high molecular weight plasma expanders (human albumin) and saline solution. High pressure was used to produce the totally fluorinated organic compounds from perfluorodecalin and perfluorotributylamine. Only those compounds which did not inhibit human lymphoid cell growth were used. The emulsifier was the ethylene oxide block-copolymer proxamol. Massive blood replacement in rats and dogs resulted in a 63% decrease in hemoglobin content. After replacement, arterial and central venous pressure decreased, but arterial-venous oxygen difference was maintained at a satisfactory level. Following the procedure, the animals were kept for two days in a chamber with elevated oxygen content and appeared normal except for sharply increased diuresis. Sixty-five of sixty-nine animals survived; the other four experienced hemorrhage from unsatisfactory hemostasis in the catheterized vessel. Cardiovascular signs were in the normal range. The amount of physically dissolved oxygen in the blood increased 308%. Venous blood pH stabilized, while dyspnea and tachycardia were absent. The preparation appears suitable for maintaining animal viability in the face of massive blood loss. Totally fluorinated organic compound emulsions are the most promising substances for large volume blood replacement. Figures 3; references 6: 4 Russian, 2 Western.  
[589-12126]

UDC 579.8.083.13:347.77

CERTAIN QUESTIONS PERTAINING TO DEPOSITION OF MICROORGANISMS IN PATENT PROCESS

Moscow ANTIBIOTIKI in Russian Vol 28, No 7, Jul 83 (manuscript received 21 Dec 82) pp 504-510

BONDARENKO, N. G. and KOROVKIN, V. I., All-Union Scientific Research Institute of State Patent Expertise, USSR State Committee for Inventions, Moscow

[Abstract] A discussion is presented of some of the problems pertaining to patents involving biotechnology, particularly the criteria used to determine the suitability of microorganisms for deposition in designated collections according to the 1977 Budapest agreement covering such eventualities. The microorganisms to be deposited must constitute the invention itself or be an innate part of an invention without which the invention would not exist, and the term microorganisms is used broadly enough to cover individual strains, culture mixtures, or associated microbes, including those carrying recombinant DNA vectors, plasmids, phages, etc. A key problem is the lack of provision for maintaining such microorganisms under conditions which would assure retention of the desired characteristics and viability. Furthermore, a special problem is posed by microorganisms underlying inventions which are already included in national or international type-collections and are generally available, or have been distributed by investigators or inventors as a matter of professional courtesy. References 4 (Russian). [629-12172]

MECHANISM OF PENICILLIN RESISTANCE IN FRANCISELLA TULAREMIA

Moscow ANTIBIOTIKI in Russian Vol 28, No 7, Jul 83 (manuscript received 26 Jan 83) pp 517-521

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[Abstract] Nineteen virulent and avirulent strains of *Francisella tularemia* were tested for penicillinase and penicillin acylase activities to determine the basis of penicillin resistance in these Gram negative bacteria. The strains were positive for both enzymes, which presumably underlie their penicillin resistance. However, there was no direct correlation between the level of activity and the degree of resistance. In addition, penicillinase production was highly temperature-dependent and at 28°C was about half the level seen at 37°C. Attempts at elimination of the penicillin resistance marker (Pen<sup>r</sup>) by cultivation in the presence of ethidium bromide, acridine orange, or sodium dodecylsulfate were unsuccessful. References 10: 6 Russian, 4 Western.  
[629-12172]

LOW MOLECULAR WEIGHT RNA IN EUCARYOTES: BIOGENESIS, SUBCELLULAR LOCALIZATION AND FUNCTION

Moscow MOLEKULYARNAYA BIOLOGIYA in Russian Vol 17, No 4, Jul-Aug 83  
(manuscript received 20 Apr 82) pp 755-783

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[Abstract] Gene organization and expression for eucaryotic low molecular weight RNA (lm-RNA), as well as its subcellular localization, metabolism and molecular evolution are reviewed. These RNA's contain 70-300 nucleotides and include a heterogeneous population of molecules found in the nucleus and cytoplasm. While genes coding lm-RNA are less than 10<sup>-3</sup>% of the eucaryotic genome, multiple scattered copies, pseudogenes, microheterogeneous sub-fractions and species variation in quantity have been found. Dispersed gene organizational type, complementarity with Alu fragments, stable transcription by varying enzymes and post-transcription processing without introns have been seen. Some lm-RNA is found in ribosomal subparticles or in nuclear pre-messenger and messenger ribonucleoprotein particles, as complexes with high molecular weight RNA or protein. They may participate in pre-m-RNA splicing and several have been shown to inhibit translation. Low molecular weight ribonucleoprotein particles observed in the cytoplasm contain one molecule of lm-RNA and several polypeptides. The strongly antigenic properties of these particles are used in their purification and study. lm-RNA's are the only RNA's which can migrate from the cytoplasm into the nucleus. Inhibitors of protein synthesis cause them to accumulate in the cytoplasm. Some lm-RNA's are widely distributed among the nuclear subfractions, while others are more localized. They are constantly and rapidly synthesized and often extremely stable after returning to the nucleus from the cytoplasm. Production of these molecules is strongly induced during active differentiation and intense metabolic activity. lm-RNA is found in all eucaryotic cells, with greater quantity and diversity in more highly evolved organisms. Antigenic similarity and sequence homology in lm-ribonucleoprotein particles from species ranging from insects to man has been noted. The results of the investigations on lm-RNA suggest that they participate directly in protein transmembrane active transport. After transcription the lm-RNA may bind to m-RNA, be transported out of the nucleus, pick up newly synthesized protein at the



ribosome (forming a transosome), return to the nucleus as a ribonucleoprotein particle, release the protein and bind to a new m-RNA. Existing experimental data confirm the universal protein transport role of lm-RNA and thus its regulatory importance. Figures 4; references 153: 10 Russian, 143 Western. [584-12126]

UDC 615.217.3.015.4:612.822.1:[612.397:612.262

EFFECT OF ACETYLCHOLINE, SOME CHOLINOMIMETICS, CHOLINOLYTICS AND DIPIROXIM ON CHEMILUMINESCENCE OF A MODEL SYSTEM OF PEROXIDATION

Moscow FARMAKOLOGIYA I TOKSIKOLOGIYA in Russian Vol 46, No 4, Jul-Aug 83  
(manuscript received 13 Dec 82) pp 20-23

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[Abstract] A suspension of rat brain synaptosomes was introduced into a model system (phosphate buffer pH 7.4, hydrogen peroxide, 0.3 percent) and eosine) and peroxidation intensity was judged by chemiluminescence. In experiments with armine, changes of luminescence of rat brain synaptosomes were studied after introduction of 0.25-0.5 mg/kg doses of the preparation. In experiments in vitro, armine was introduced into a model system containing intact rat brain synaptosomes. Acetylcholine, diisopropylfluorophosphate (DFP), oxazyl, atropine, scopolamine, dypiroxim and mebikar were studied in vitro. Chemiluminescence decreased after addition of rat brain synaptosomes. A peroxidant effect, manifested by elimination of the effect of antioxidants in the rat brain synaptosomes, occurred in the presence of brain synaptosomes of rats poisoned by lethal doses of armine. Chemiluminescence became less obvious and less constant after lower doses (0.25-0.3 mg/kg) of armine even in the presence of clinical signs of armine poisoning (spasm, salivation). Addition of acetylcholine, armine, DFP or oxazyl at concentrations of  $1 \cdot 10^{-4}$ - $1 \cdot 10^{-3}$ M intensified chemiluminescence. Atropine and scopolamine did not affect chemiluminescence but dypiroxim produced a pronounced antioxidant effect. The experiments indicated that the toxic effect of anticholinesterase agents may be realized through activation of systems which initiate lipids peroxidation. Figure 1; references 22: 19 Russian, 3 Western.  
[601-2791]

# MONOAMINERGIC COMPONENT IN EFFECT OF D-9-TETRAHYDROCANNABINOL ON CONDITIONED REFLEX ACTIVITY

Moscow FARMAKOLOGIYA I TOKSIKOLOGIYA in Russian Vol 46, No 4, Jul-Aug 83  
(manuscript received 13 Sep 82) pp 23-26

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[Abstract] Experiments were performed on cats, pretrained with the aid of a method of conditioned-protective reflexes, to differentiate two differently oriented lines presented at different time exposures (300-3000 us). Serotonergic, dopaminergic and adrenergic agents were introduced intraperitoneally in analyses of the effect of D-9-tetrahydrocannabinol on the conditioned reflex activity. A 3 mg/kg dose of D-9-tetrahydrocannabinol (D-9-THC) impaired differentiation of short-term and long-term visual stimuli and increased the latent period of the conditioned reflex to differentiated visual stimuli. Participation of serotonin-, dopamine- and noradrenalinergic systems in producing the effects of D-9-THC was confirmed. The change of effect of D-9-THC under the influence of substances changing the activity of the monoaminergic systems was due to the fact that the behavioral effects of D-9-THC, in their turn, are caused by differently-directed variations of the activity of these systems under its effect. The different effect of dopaminergic substances on differentiation of long-term stimuli and differentiation of short-term stimuli was due to the heterogeneity of the functional systems which ensure perception of these two signals. References 21: 6 Russian, 15 Western.  
[601-2791]

UDC 616.98:579.861.2]-099

## STAPHYLOCOCCAL ENTEROTOXINS

Moscow VOPROSY PITANIYA in Russian No 4, Jul-Aug 83 (manuscript received 5 May 82) pp 11-15

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[Abstract] A brief survey is presented of the published literature on the six recognized staphylococcal enterotoxins (A, B, C, D, E and F), covering cultural conditions favoring their formation, techniques of detection and characterization, and various forms of chemical and physical inactivation in vitro. While the conditions under which these enterotoxins are formed in food are fairly well known, their inactivation or elimination has presented a problem in situations where the foodstuff is to be retained. Although generally regarded as thermostable, some commercial success has been achieved in the inactivation of enterotoxins by heat treatment of foodstuffs (20-30 min at 120°C). References 61: 7 Russian, 54 Western.  
[632-12172]

## USE OF NEW ORGANOPHOSPHORUS INHIBITORS CONTAINING CARBOMETHOXYL GROUP FOR IDENTIFYING INSECT CARBOXYLESTERASE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 270, No 2, May 83  
(manuscript received 13 Dec 82) pp 470-473

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[Abstract] Polyacrylamide gel disk electrophoresis was used to study the heterogeneous esterase composition of *Schizophis gramina* Rond and *Peziplaneta americana* L, with the aid of chromogenic or dye-reacting substrates and selective inhibitors. New O-alkyl-methylthiophosphonate highly selective carboxylesterase inhibitors were synthesized and investigated. These compounds had the general formula  $\text{CH}_3(\text{RO})\text{P}(\text{O})\text{SCH}_2\text{SCH}_2\text{COOCH}_3$ ; R and  $\text{C}_8\text{H}_{17}$ ,  $\text{C}_9\text{H}_{19}$  or  $\text{C}_{10}\text{H}_{21}$ . Kinetic studies showed the new inhibitors to be about 1000 times more active against insect carboxylesterases than against cholinesterase, which greatly exceeds the selectivity of triorthocresylphosphate or O,O-dimethyl-O-(2,2-dichlorovinyl)-phosphate. This selectivity is due to the more hydrophobic environment of the serine hydroxyl group in carboxylesterases, as compared to cholinesterase. Electrophoresis of *Schizophis* Triton X-100 extracts gave 8-9 esterase fractions; the first four were cholinesterases, while the most mobile was arylesterase. Fractions 5-7 were carboxylesterases. In studying *Peziplaneta*, 12 fractions were obtained, with fractions 1-3 identified as cholinesterases and all the rest as carboxylesterases. The data clearly demonstrate the superiority of the new inhibitors for the study of carboxylesterases, so that these inhibitors are recommended for the investigation of organophosphorus pesticide resistance. Figures 2; references 8: 4 Russian, 4 Western.  
[589-12126]

UDC 577.152.277:577.323.5

## SPECIFICITY OF NUCLEASE FROM CENTRAL ASIA COBRA (NAJA NAJA OXIANA) VENOM FOR POLYRIBONUCLEOTIDE MACROSTRUCTURE

Moscow MOLEKULYARNAYA BIOLOGIYA in Russian Vol 17, No 4, Jul-Aug 83  
(manuscript received 6 Aug 82) pp 818-826

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[Abstract] The influence of secondary and tertiary substrate structure on hydrolysis was studied using Central Asia cobra venom nuclease. Hydrolysis

was studied in a pH-stat, with pH maintained at 7.8 with 0.1 M NaOH. Degree of reaction was measured by subsequent addition of RNAase and chromatography on DEAE cellulose. The rate of reaction observed for homopolynucleotides was: poly (A) faster than poly (C), which was faster than poly (I), which was faster than poly (U). Poly (G) showed practically no activity. This suggests that the venom nuclease prefers the type A spiral. To confirm this hypothesis, double-stranded poly (A)-poly (U) and poly (G)-poly (C) hydrolysis was measured. The rate was found to correspond to that seen for the component which was the best substrate alone. Double stranded poly (U) was hydrolyzed about ten times faster than single, while the rate of poly (A) degradation was not significantly increased by double strandedness. When used to break down r-RNA or t-RNA, the cobra venom nuclease exhibited concentration independent autoacceleration, which was inhibited by addition of fresh substrate. The t-RNA also inhibited poly (A) hydrolysis. The data indicate the formation of an extremely stable complex between the nuclease and t-RNA. The first hydrolytic chain breaks should increase the structural flexibility of the t-RNA, facilitating subsequent hydrolysis and enzyme-substrate-complex dissociation. Electrophoresis of  $^{32}\text{P}$  end-labeled t-RNAP<sup>he</sup> revealed that the phosphodiester bonds at positions 28, 41 and especially 67-71 are most sensitive to attack. The results suggest a region of high affinity between the nuclease and t-RNA. Figures 7; references 19: 7 Russian, 12 Western.  
[584-12126]

UDC 577.112.6:543.544

#### HIGH PERFORMANCE LIQUID CHROMATOGRAPHY OF PROTECTED PEPTIDES ON SOFT AND SEMIRIGID GELS

Moscow BIOORGANICHESKAYA KHIMIYA in Russian Vol 9, No 5, May 83  
(manuscript received 28 Sep 82; in revised form 11 Nov 82) pp 616-627

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[Abstract] An evaluation was conducted on the separation of protected synthetic peptides representing derivatives of neurotoxin II isolated from the venom of the Central Asian cobra *Naja naja oxiana*, by means of high performance exclusion liquid chromatography utilizing soft gels (hydroxypropylated dextrans Sephadex LH-20 and LH-60; poly-N-morpholine gel Enzakryl K) and semirigid gels (polyacrylmethacrylates Spheron P-40, P-300, and P-1000). Superior results were obtained by fractionation on Sephadex LH-20. LH-60 possessed unsatisfactory mechanical properties under the conditions employed, while Enzakryl K-2 showed retention of peptides with a free carboxyl group. The Spheron gels showed poor resolution in terms of the peptides used and appears to require a five-fold difference in the molecular mass of peptides for their satisfactory resolution. Figures 15; references 23: 4 Russian, 19 Western.  
[633-12172]

UDC: 613.6:625.78

PHYSIOLOGICAL INVESTIGATIONS OF THE EXPERIMENTAL WORK AND REST SCHEDULE FOR WORKERS EMPLOYED IN CONSTRUCTION ON TRUNK PIPELINES

Moscow GIGIYENA TRUDA I PROFESSIONAL'NYYE ZABOLEVANIYA in Russian No 11  
(manuscript received 14 Apr 82) Nov 82 pp 12-16

[Article by Yu. M. Bagdinov, All-Union Institute for Construction of Trunk Pipelines, Moscow]

[Text] The passage of trunk pipeline right-of-ways across areas with complex climatogeographic conditions (large number of rivers, existence of swampy and mountainous stretches, harsh temperature conditions in the northern regions of this country, etc) greatly complicates pipeline construction and reduces available construction time within a calendar year. In Western Siberia, for example, for all practical purposes the pipeline construction season runs from November through April. This requires a maximum possible increase in the pace of construction activities during that time of the year which is favorable for construction. It is this which dictates the introduction in construction organizations of a work schedule with an integrated work time count. Such organization of labor specifies the adoption of work periods with increased length of work day and work week for a specified length of time, with subsequent compensation for extra time worked in the form of time off or a reduced workday within a given work period.

Of particular importance in these conditions are matters pertaining to making work and rest schedules more efficient, achievement of which should foster increased labor productivity and diminished worker fatigue under the effect of work stress loads.

Analysis of data in the literature (V. V. Kolpakov, P. P. Solodukhin, Yu. M. Bagdinov et al.,) indicates the possibility of various reactions of systems and functions of the human organism with a work schedule involving an integrated work time count.

At the same time the special conditions of pipeline construction (continuous advance of the spread, complexity of organization of living conditions in the field, frequently in sparsely populated area) dictate the specific peculiarities of matters of work and rest schedule, methods and means of maintaining functional activity and preventing extreme worker fatigue. These specific features consist in the need to provide a combined solution to problems of organizing work and rest, worker off-duty routine and diet, in combination with preventive medical measures and monitoring of the afterwork rest schedule.

On the basis of the results of comparative studies of existing work and rest schedules for welding crews (Yu. M. Bagdinov et al.), we devised an experimental schedule, prepared and confirmed a program for adopting it.

Experimental adoption of the proposed work and rest schedule (Figure 1) was accomplished in a welding crew on an oil trunk pipeline right-of-way in the northern part of Western Siberia, and during the period of schedule testing and approval we organized the daily activities, feeding, and rest for the welding crew on the right-of-way, directly within the work spread zone (within a distance of 10 minutes driving time). In-shift work time duration was 10 hours, with simultaneous organization of labor, with the shift beginning at 0800.

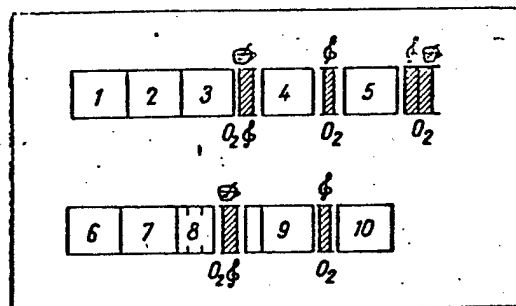


Figure 1. Pipeline Construction Worker Work and Rest Schedule.

The Arabic numerals indicate working hours; the shading indicates work breaks; O<sub>2</sub> -- measured administration of oxygen; treble clef -- music and literary broadcasts.

During the shifts we tested a schedule with five rest and meal breaks (the first -- 15 minutes, second -- 10 minutes, third -- 30 minutes, fourth -- 15 minutes, fifth -- 10 minutes). In order to relieve fatigue and accelerate restoring work efficiency during the breaks, we played broadcasts of music, humorous stories, and applied measured doses of pure, moisture-added oxygen. We additionally scheduled five meals a day for the workers (breakfast, brunch, lunch, dinner, supper), with mandatory monitoring of menu and caloric content of meals. After completing a shift, workers would bathe, take oxygen, and we tested the possibility of performing self-massage and mutual massage, employing portable home massagers. Worker rest was also monitored.

Measures conducted after work were for the purpose of maximally increasing after-work rest time by bringing living quarters closer to the work area, by establishing mobile crew living quarters. The aggregate of preventive-medical procedures (bath, oxygen, massage), a rational diet and music broadcasts were to help speed up recovery from fatigue and help the workers rapidly switch psychologically to a rest regimen.

During the process of the experiment we conducted dynamic observations of the condition of the principal systems of the arc welders' organism throughout the course of the work day and work week, and we compared them with corresponding indicators for the arc welders of that same group prior to initiation of the experimental regimen, as well as with indicators obtained from arc welders in this country's central zone working a normal workday.

Study of the state of the cardiovascular system according to pulse rate during work indicates that adoption of the experimental schedule helps stabilize functioning of the cardiovascular system. The pulse rate of arc welders in this group varies over the course of the work day and week across the same range as that of arc welders in the central zone, and is below 100. This enables us to state that the functional loads on the cardiovascular system of the arc welders in the crew under observation correspond to the loads noted during performance of jobs of average physical difficulty. Before introduction of the experimental schedule, the pulse rate of the workers in this group reached 110 by the end of the workday at the beginning of the week, and 115 by the end of the week, that is, the nature of changes in the cardiovascular system corresponded to deviations noted during heavy physical labor.

Investigation of the functional state of the central nervous system on the basis of change in rate of reaction to stimuli in the dynamics of a work shift indicates that the degree of retardation of reaction in the workers of the brigade under observation by the end of a work shift amounted to 15 percent in respect to the initial level at the beginning of the week, increasing to 17.8 percent by the end of the week. Prior to introduction of the experimental schedule, slowing of the reaction rate was of a more substantial nature (by 16.7 percent on the first day of the week, by 17.8 percent on the fourth, by 21.2 percent on the fifth, and by 24.0 percent on Saturday), that is, the appearance of elements of cumulative fatigue was noted by the end of the week.

Investigation of the nature and magnitude of changes in how long arms can resist a static force also indicates a substantial decrease in the degree of worker fatigue as a result of adoption of the experimental schedule. Prior to adoption of an efficient work and rest schedule we noted a decline in level of endurance which is characteristic of heavy physical work (by the end of the shift endurance had declined by 24.5 percent, and to 33.8 percent by the end of the week), while after introducing a more efficient work and rest schedule changes in endurance in the dynamics of a work shift and work week decreased to the level of physiological fluctuations noted in performing work of average physical difficulty (an endurance decline of 14.9 and 18.2 percent respectively).

An investigation of thresholds of vision indicates that their change, attesting to level of fatigue of the visual analyzer, in the course of a workday and work week is of a uniform nature in the arc welders of the observed brigade with the functional fluctuations noted in arc welders in the central zone. There was noted in workers of the central zone an increase in visual thresholds of 20.2 percent in the dynamics of the first day of the week, and an increase of 28.9 percent on the last day of the week, while in arc welders of the brigade in which the proposed work and rest schedule was tested, the figures were 21.7 and 31.9 percent respectively (the difference is not statistically significant).

We should note that prior to adoption of a rational work and rest schedule, appearance of indications of fatigue in the visual analyzer in arc welders working in the northern part of Western Siberia was of a more substantial nature by the end of the work shift and particularly the end of the work week (rise in visual thresholds was 33.7 percent by the end of the first day of work, and 50.7 percent by the end of the sixth, that is, on Saturday).



Analysis of the dynamics of the indices of all investigated systems indicates that by the end of the week there is noted in all observed groups a change in initial indicators at the beginning of the work shift. This indicates the appearance of signs of cumulative fatigue by the end of the week in the principal systems of the workers' organism. At the same time, however, in conditions of the experimental schedule, signs of cumulative fatigue did not appear until the last day of the week.

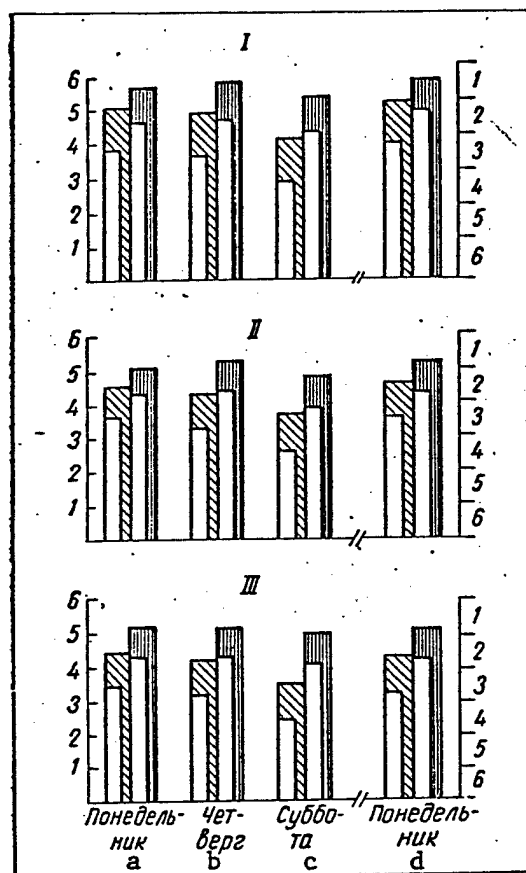


Figure 2. Change in Indicators of Subjective Physical Well-Being, Activeness and Mood in Arc Welders in the Course of the Workday and Work Week.

On the Y axis -- SAN psychological test score points; on the X axis -- days of the work week; columns with oblique hatching -- SAN test indicators at the beginning of the workday, before introducing the experimental work and rest schedule; columns with vertical hatching -- following adoption of new schedule; columns without hatching -- SAN test indicators at end of workday; I -- subjective physical well-being: 1 -- good; 2 -- satisfactory; 3 -- average; 4 -- below average; 5 -- poor; 6 -- very poor; II -- activeness; 1 -- high; 2 -- elevated; 3 -- average; 4 -- reduced; 5 -- low; 6 -- very low; III -- mood: 1 -- good; 2 -- satisfactory -- 3 -- average; 4 -- fair; 5 -- poor; 6 -- very poor.

a -- Monday; b -- Thursday; c -- Saturday; d -- Monday

Full recovery of the functional properties of all systems of the organism in the arc welders of the observed brigade following a day of rest is indicated by the initial levels and dynamics of the indicators of all investigated systems on the following Monday, which do not differ from those on the preceding Monday. Prior to adoption of the experimental schedule, full recovery of functioning of systems following a day of rest was not observed in this same group of workers. The obtained data indicate that with organization of jobs with integrated work time count, a rest day at the end of each week should be mandatory.

We also employed the SAN psychological test (V. A. Doskin et al.) to investigate the functional condition of workers. The obtained data (Figure 2) and the performed evaluation of the significance of differences in indicators between groups according to the Wilcoxon-Mann-Whitney criterion indicate with a high degree of reliability a substantial improvement in subjective physical well-being, activeness, and mood both in the course of the workday and in the course of the work week on the part of workers following adoption of the experimental work and rest schedule.

Observation time-study data and evaluation of brigade output indicated a 15 percent increase in shift and week labor productivity.

The materials of the study, after a number of additions had been made, were used in drawing up the "Provisional Regulations on Work and Rest Schedule for Trunk Pipeline Construction Workers," which were prepared in agreement with the Health Protection Administration of the RSFSR Ministry of Health attached to the Ministry of Construction of Petroleum and Gas Industry Enterprises, with the Central Committee of the Trade Union of Oil and Gas Industry Workers, and was approved by the Ministry of Construction of Petroleum and Gas Industry Enterprises.

**Conclusion.** Organization and conditions of construction of trunk pipelines require comprehensive solution of problems pertaining to schedule and conditions of work and rest, off-duty activities and meals, as well as the performance of preventive medical procedures for the purpose of preventing excessive fatigue of the workers' organism.

Adoption of the experimental work and rest schedule helps increase labor productivity and improve functioning of the principal systems of the organism and the workers' psychological mood.

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DEMOGRAPHIC AGING AND PROBLEMS OF PUBLIC HEALTH

Moscow SOVETSKOYE ZDRAVOOKHRANENIYE in Russian No 6, 1983 (manuscript received 15 Nov 82) pp 12-16

[Article by D. F. Chebotarev, Gerontology Institute of the USSR Academy of Medical Sciences, Kiev]

[Text] The aging of the population is one of the most important problems of our time; today it is taking on immense importance in the economics and social policies not only of industrially developed countries, but of developing countries as well.

Throughout the world more and more people are reaching old age. If we adhere to age 75 as the definition, then in the present and for several generations in the future for the first time in history there will be not a select minority, but a majority of the population with the possibility of reaching old age.

The increase in lifespan is a result of the development of human society and culture, which should be viewed as an inevitable and positive achievement, but which demands constant attention and appropriate actions on the part of those who direct states' demographic policies.

According to data from the United Nations\*, in 1950 there were approximately 200 million people age 60 or older. By 1975 this figure had reached 350 million. According to UN forecasts, by the year 2000 this indicator will reach 590 million people, and by 2025, it will exceed 1.1 billion; this would be a 224 percent increase over the 1975 figure. It is expected that during that period the world population will increase from 4.1 billion to 8.2 billion people; this represents a 102 percent increase. In 45 years the proportion of aging people in the total world population will be 13.7 percent. Today in developed countries the proportion varies between 12 and 23 percent, and in developing countries it varies between 4-7 percent.

If the existing trends in the ratio between the sexes are maintained (that is, the number of men per 100 women), there will be an imbalance in the developed

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\*"Materialy Vsemirnogo Assamblei OON po stareniiu" [Materials on the United Nations World Assembly on Aging], (A/conf. 113/MC/L.27-4/Aug 1982).

regions of the world, but some improvement is expected. For example, in 1975 this ratio was 74 men per 100 women in the 60-69 age group; by 2025 it is expected to increase to 78; and in the over 80 age group, it should increase from 48 to 53. Thus, in the future women will account for the majority of people in the old age group. This situation should be taken into account in connection with its influence on living conditions, income, health care, and other systems that provide support for the elderly.

The UN forecasts for the increase in life expectancy among people who reach 60 years of age are quite modest. In developed regions there is an expected increase of only one year between 1975 and 2025; that is, men who reach the age of 60 are expected to live another 17 years, and women another 21 years.

Over the course of the next two decades in developed countries there will be an especially rapid increase in the number of people who reach the age of 80. For reasons that are well understood, the increase in this age group--the very aged--has special significance in problems involving practical gerontology, and planning and organization of all measures of an economic, social, and medical nature.

In the last 2-3 decades various countries and international associations have started to pay more attention to social, economic, political, and scientific problems that are arising in connection with the progressive demographic aging.

In the last two years alone two worldwide forums have been held, at which prospects for research on problems of gerontology were discussed, in addition to a program of action at national and international levels in connection with aging. The first of these was the 12th International Congress of Gerontologists in Hamburg (July 1981), at which the first and last plenary sessions were devoted entirely to achievements and prospects in the development of scientific and practical aspects of gerontology. The second was the United Nations World Assembly on Aging in Vienna (August 1982), in which representatives of 124 UN member countries participated; this assembly presented some unique opportunities for discussion and for calling for international action to resolve the many problems associated with aging.

Today questions involving demographic aging are being considered more and more broadly at the national, regional, and international levels.

There are many problems and needs that are common to people who have reached retirement age and to the entire population, however there are some which reflect the special nature and needs of the elderly.

Foremost are problems of health care, involving the specifics of medical and social assistance. Inseparable from these are problems involving employment--continuing labor activity, preparing for retirement, definition of a prudent way of life, the position of the elderly person in family and society, his education, and so on. The study of the social and economic consequences of aging in the population is also important, particularly the influence of this factor on production, and the status of manpower resources. Studying the problems of aging is necessary for proper planning of the economy, and determining a program of action at the national level.

For a proper definition of the tasks in the area of health care, one must take into account that along with an increase in lifespan, a certain degree of improvement in the health of the aging is also being noted. Age is not being associated as much with obligatory physical weakening, diseases, and social and economic dependence. Activity and participation in professional and social life have become necessary for the majority of elderly people. It is now a commonly held opinion, emphasized by the leadership of the World Health Organization, that elderly people represent a group in the population that requires special protection, but at the same time, they are capable of making an important contribution to society's development.

In resolving health care, social, and hygienic problems, it is extremely important to take into consideration the fact that people age differently. The aging process is the result of the interaction of biological and social factors and lifestyle, which cause very diverse changes in the structure and function of the aging body. As a result, elderly people of the same age represent heterogeneous groups. In connection with this, chronological, or calendar age loses significance as a simple basis for determining possibilities and needs of elderly people; and the determination of the biological age and an individual's functional possibilities takes on greater importance.

In foreign literature we are encountering more and more often the question of dividing people of the same age into "young" elderly and "old" elderly on the basis of their health status and social indicators. Today, according to rough estimates, in developed countries "young" elderly account for 80-85 percent of the people 60 years old and over, and "old" elderly account for 15-20 percent. The proportion of the latter increases in the older age groups, but even among people 80 years old and over, there are many people without serious illnesses, who are essentially healthy, and therefore can be placed in the "young" elderly group.

The determination of biological age as a measure of a population's health is of great individual and social importance, in particular for the proper utilization of the working capacity of elderly people, and the rational organization of medical and social assistance. Data from observations made at health care centers play a decisive role in the practical determination of biological age. It is very important to have a system of criteria that can determine the potential possibilities of the aging body--that is, its future. Also needed is further extensive research on the application of work-load tests, new methodical approaches which make it possible to study the aging body's functional possibilities. Comprehensive, long-range studies need to be implemented extensively. The problem of determining biological age is tied inseparably to this type of research.

In the contemporary world, the perception of a person who has reached retirement age as someone who is helpless and useless to society is no longer true. Today the critical question has arisen of the right of elderly people to continue working, and as far as possible, their professional activity; to play an active role in society; and to make an important contribution in the development of many spheres of life. While in Western countries age discrimination in labor, caused by unemployment, presents an obstacle to

fulfilling this right, in our country and in other countries in the socialist system people's labor has crossed over the retirement age boundary and is encouraged by government directives.

In the Report to the 26th Congress of the CPSU Central Committee, L. I. Brezhnev pointed out that drawing our veterans of labor into labor activity, taking into account their possibilities and the needs of the national economy, is under contemporary conditions a very important task.

The labor of retirees in the sphere of their professional activity has more than a direct national economic significance. Experience shows that continued work, within one's abilities, has an immense positive effect on the health of elderly people. Working retirees require less care and attendance on the part of the rest of the working population, they are ill less often, and maintain a sense of social worth, usefulness and family prestige longer.

The results of social and hygienic research on problems of health, working ability, and health care among elderly people lead us quite clearly to a number of very important conclusions. The primary one is that the utilization of the remaining working ability of retirees in the national economy is clearly inadequate. Naturally the question arises, why is there low over-all employment among retirees, which has not risen substantially over recent years, in spite of the opportunity for the majority of retirees to receive both a pension and salary? The answer is simple: the reduced working capacity of the elderly person's body means that easier work is required; and that ample opportunity (before a person reaches retirement age) should be provided to learn new processes that will make the work easier, and that can be utilized by elderly people. In other words, in order to keep the aging person as a working member of the collective, the management of an enterprise should provide the practical opportunities for retirees to continue their work activities.

Sociological research studies have been conducted in a number of our cities over recent years, which have shown that from 30 to 50 percent of the retirees in the first 10 years of retirement want to return to work under the condition that the work is made easier.

Medical personnel (primarily the medical-sanitary units of enterprises) should help retirees realize this desire. Their task is effective preventive health care and evaluation of the remaining working capacity of those people of retirement age who are still working.

Every person should start preparing for retirement 1-2 years before reaching retirement age; this is a preventive measure to be implemented with consideration of a whole series of medical, psychological, social, and hygienic factors. Preparing for retirement and providing people of pre-retirement age with preventive health care and rehabilitation measures, is part of a new branch of health care which has already acquired its own specific features, and is closely tied to problems of social assistance and is now being developed extensively in many countries.

The problem of employment and preparing for the transition to retirement age is one of the basic problems among those tied to premature aging, and to the position of elderly people in society and the family. The emergence of this problem emphasizes the need for intersectorial cooperation, and a comprehensive, interdisciplinary approach to resolving the problems of the elderly.

In the section "Principles of an International Plan of Action" of the UN Assembly on Aging, a very important point is included in the form of a recommendation made by the national governments; its content corresponds fully to the conclusions reached by Soviet sociologists. It points out that aging is a process that lasts throughout the entire life of an individual. Preparing the population for the later stages of life should be an integral part of social policies and should include physical, psychological, cultural, economic, medical, and other factors. It also emphasizes that recognition of the interrelation among all the aspects of aging implies the need for a coordinated approach to policies and research on this issue.

Another very important problem is medical assistance, and social assistance, which in geriatrics is inseparable from the medical care. In health care this is distinguished as geriatric assistance. Over the last two decades, a certain amount of clarity has been brought to this problem, and international and national experience has been acquired, in our country and in European socialist countries in particular. In the formulation of the basic principles for geriatric assistance in an international plan of action for problems of aging, the United Nations points out that concern for the elderly should go beyond the limits set by an orientation toward illness. The interdependence of physical, psychological, social, and emotional factors, as well as environmental factors, should be taken into consideration. Therefore, the health of the elderly is the concern of health care and social insurance agencies, and the family. Efforts made in the area of health care, particularly in providing primary medical care, should be directed strategically toward providing aging people with the opportunity to live an independent life as long as possible in the family and society. It is emphasized that primary medical services for the very old include utilization of personnel from medical and social services, with help from volunteers who have been trained in simple methods used in caring for the very old.

It is also necessary to know the dimensions of medical and social assistance required in various regions of the country with different levels of demographic aging. In recent years some very valuable data have been obtained by the Gerontology Institute of the USSR Academy of Medical Sciences, which studied the health status and demand for medical and social assistance among the elderly population in typical regions of a major city (Kiev) under a WHO program (1978). It turned out that the proportion of people with limited possibilities for taking care of themselves among elderly people 60-74 years old was 7 percent for those living alone and 14 percent for those living with families. In the older group (75 years old and over) this percentage was higher--22 percent among those living alone and 56 percent among those living with families.



The retiree in our country is the object of concern of a number of departments and organizations, including social organizations of the retirees themselves; these organizations should do everything possible to campaign for the organization of mutual assistance, making use of the experience that has been accumulated. It is important that there be further improvement in the interdepartmental coordination of measures directed at protecting the health of the large groups of people who have reached retirement age.

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LONGEVITY AND LIFESPAN IN KIRGHIZ MEN AND WOMEN

Moscow SOVETSKOYE ZDRAVOOKHRANENIYE in Russian No 6, 1983 (manuscript received 31 May 82) pp 16-19

[Article by L. S. Burmin, candidate of medical sciences, Frunze City Health Department, Kirghiz SSR; I. A. Asanbekov, director]

[Text] The question of the discrepancy in lifespan between men and women is of interest to scientists in various fields of specialization in many countries. N. N. Sachuk (1970) believes that the reasons for the discrepancy demand in-depth study. B. Ts. Urlanis (1979) notes that in all the countries of the world the difference in the lifespans of men and women is growing steadily, and there is no reason to believe that this trend will change its direction.

According to WHO data<sup>1</sup>, in 1968 the mean lifespan in 14 European countries had reached 68.8 years for men and 74.6 years for women. The longest lifespans were in Sweden, Denmark, and the Netherlands: for men, 70-71 years and for women 75-76 years. In the USSR in 1970 the mean lifespan for men was 65 years, and for women it was 73 years. Longer lifespans for women are seen in almost all developed countries (the differences range from 2 to 9 years).

Over the course of the last 2-3 decades the average lifespan for men has not increased, and there is even a declining trend with a continued increase in women's lifespans.

Scientists in many countries are working on an explanation of this problem. They are studying biological factors, tied to physiological, genetic, and constitutional peculiarities of the female organism and the fulfillment by the female of the child-bearing function. In addition to this, in various countries women are participating to varying degrees in national production, and their lifestyles and the way in which they manifest illness are different. B. Ts. Urlanis (1979) notes that the sexual composition of the population in many countries has certainly been affected by war and migration processes; he emphasizes, however, that this alone cannot explain the current structure of the population.

<sup>1</sup>Eitner, S. et al., *Practische Gerohygiene*. Dresden, 1975, p 25.

In the majority of countries in the world, for every 100 girls there are an average of 104-107 boys born; that is, every year in the world approximately 4 million more boys are born than girls. By the age of 15-20 years, the ratio between the sexes evens out as a result of a higher mortality rate among boys.

According to international statistical data, by the middle of 1978 there were 10 million fewer men than women in the world. In the United States the average lifespan in 1975 was 68.7 years for men and 76.5 years for women. The greatest disproportion is found in countries of southern Asia and in China. Taking into consideration the large population of this region, this has a significant effect on the sexual composition of the world's population. In developing countries, where the proportion of children is almost twice that in developed countries, the percentage of men is correspondingly higher.

Another factor affecting the sexual composition of the population is the ever-increasing difference between the lifespans of men and women, which is especially characteristic for developed countries. In Finland there is a difference of 9.1 years; in France it is 8 years; in the United States it is 7.8 years; and in Great Britain, Austria, and Canada, it is over 7 years.

N. N. Sachuk did a review of statistical materials from 60 countries for all the years of the 20th century, which made it possible to discover the specific characteristics of lifespans for men and women in various parts of the world. The regional characteristics of longevity indicators for men and women are divided into three types.

The first type occurs against a background of high longevity indicators (30,000-45,000 of every 100,000 people born reach the age of 80); there is a relatively small difference in this indicator depending on sex, with a higher indicator occurring among women (12,000 to 15,000 higher). This situation is seen in Denmark, Norway, the Netherlands, and Sweden.

The second type occurs against a background of moderate longevity indicators (20,000-30,000 of every 100,000 people born reach the age of 80); and there is the greatest difference between the longevity indicators for men and women (18,000-20,000 higher among women), and there is a small increase in the difference between the indicators for the sexes (in England, Austria, Canada, USSR, and France).

The third type occurs against a background of low longevity indicators (5,000-10,000 of every 100,000 people born reach the age of 80); the longevity indicators for women are slightly higher than for men (by 1,000-5,000 people); and there is a slow rise in this figure over the years (in India, Greenland, Pakistan, and elsewhere).

Developing countries occupy an intermediate place; the longevity indicators for women exceed those for men only moderately against a background of generally low longevity indicators.

Data for the Kirghiz SSR (see the table) show that in terms of longevity indicators, it belongs to the second type, as does our entire country.

It is well known that the demographic mechanism involved in the formation of the difference in longevity among men and women can be discovered best through an analysis of age mortality rates. Over the last 30 years, mortality indicators among men in Kirghizia have been significantly higher than those for women (L. S. Burmin; V. A. Petros'yants and L. S. Burmin). In 1979 the mortality rate among men aged 25-55 was twice as high as that among women. The pattern of the high male mortality (taking into account all the reasons) shows that the greatest "contribution" to the mortality rate is made by diseases of the cardiovascular system and respiratory organs, and malignant neoplasms. In cities of Kirghizia, in the 50-70 age group, deaths from these causes among men exceed those among women by a factor of 1.5-2.

#### Health and Longevity Indicators

<u>Indicator</u>	<u>Ukrainian SSR</u>		<u>Kirghiz SSR</u>	
	<u>Men</u>	<u>Women</u>	<u>Men</u>	<u>Women</u>
Percentage of people 80 yrs old and over, with over-all "good" health	43.2	29.7	49.8	34.8
Number of people who reach the age of 80 (per 100,000 people born), thousands	28.1	43.6	23.1	43.3
Average life expectancy after the age of 80, years	6.8	7.6	6.3	7.1
Percentage of essentially healthy people in the 80-89 age group*	46.0	33.3	49.6	34.8
Percentage of people 90 yrs old or over (according to data from medical examinations)	31.6	20.2	32.9	22.0

\*Essentially healthy means that these people are not suffering from any chronic illnesses, they feel strong and vigorous; memory and mental function are not impaired, or if there is impairment it is insignificant; they are sufficiently mobile, interested in their surroundings, and not only take care of themselves, but also carry out a number of tasks at home and elsewhere.

In cities throughout the republic the mortality rate from cardiovascular diseases is higher by a factor of 1.5-2.5 among men aged 25-80 than among women. Mortality from respiratory diseases, digestive tract diseases, and malignant neoplasms is higher by a factor of 1.5 among men aged 45-70 than among women. In Kirghiz cities in 1978-1979, the average lifespan indicators for women were higher than for men. This difference decreases with age.

In order to gain an understanding of longevity in Kirghizia we studied the health of elderly and very aged people. Materials from a special medical and social investigation of about 2000 people living in various climatic and geographic zones of the republic, which was conducted under the guidance of associates of the Gerontology Institute of the USSR Academy of Medical Sciences (Kiev), showed that the health status of elderly women and very aged women was substantially worse than that of the men.

For convenience in comparing data from Kirghizia with data from other Union republics, we utilized a system with three categories for health status ("good",

"fair", and "poor"). Included in the group of people receiving the medical evaluation of "good", were essentially healthy, active people with a feeling of well-being, memory and mental functions without substantial impairments, good hearing and vision, and who were able to take care of themselves independently and showed an interest in their surroundings. The "poor" rating was given when people did not feel well, complained of extreme weakness, had very limited mobility, and required outside assistance and care. Senile and seriously ill individuals were included in this group.

The indicators of mobility and ability to care for oneself were better among men; they had better memory function and showed greater interest in their surroundings. Women had better vision and hearing, and they worked more around the home and elsewhere.

The table shows a comparison of health and longevity indicators in the Ukrainian SSR and the Kirghiz SSR. The data presented contradict each other. Women have poorer health, but the longevity and lifespan indicators are higher.

The differences in health among very old men and women are the result of the high mortality among middle-aged and older men, when the weaker and sicker men are "sifted out". In addition to this, the differences in the health indicators for men and women apparently are tied to more difficult living conditions experienced by women; they have in addition to a production load that is equal to men's, a great workload at home and they also carry out responsibilities connected with motherhood. Scholars studying this problem have reached the conclusion that the female organism is more viable since women are subjected to fewer harmful external influences. The fact that women smoke significantly less and abuse alcohol less than men is also taken into account.

The differences in the lifespans of men and women can also be explained by the difference in the degree of development of atherosclerosis and the specific ways in which the male and female organisms age. N. N. Anichkov and G. F. Lang indicated that atherosclerosis develops 10 years earlier in men than in women. Signs of atherosclerosis are more pronounced in men up to the age of 60. Harris (1970) indicated the signs of atherosclerosis increase among men between the ages of 30 and 49. The greatest development and the most acute clinical signs of atherosclerosis are noted between the ages of 50 and 59. Among women the signs of atherosclerosis increase between the ages of 40 and 80.

D. A. Chebotarev notes that the connection between age-related physiological characteristics of the organism and atherosclerosis is a pivotal problem in gerontology. Resolution of this problem would point the way toward pathogenic prevention of the aging process.

Study of the factors that determine the mortality rate in general, and the high mortality rate among men in particular, will make it possible to develop a set of measures directed toward reducing the discrepancies in the mortality rate of the sexes and toward increasing lifespans.

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METHODOLOGICAL BASES OF INTERDISCIPLINARY APPROACHES TO INTERGRATION OF SCIENCES IN HEALTH FIELD

Moscow VESTNIK AKADEMII NAUK MEDITSINSKIKH NAUK SSSR in Russian No 7, Jul 83  
(manuscript received 12 Nov 82) pp 3-8

BORODIN, Yu. I., Novosibirsk

[Abstract] The vital importance of interdisciplinary approaches to integration of the sciences in the health field is discussed. This integration becomes more urgent in view of the unprecedented consequences (some unknown) of the increasing interaction of man and the external environment and calls for development of a purposeful system of control of man's interaction with his external environment. The importance of considering old scientific views in the development of new views is emphasized. This integration should proceed in three basic directions: the interaction of medical-biological sciences with other sciences, the interaction of medical-biological sciences and the rapid incorporation of scientific developments into the health field. The integration should be carried out by supervisory agencies, institutions and specialists working in natural, technical and social sciences and institutions and specialists working in the medical-biological sciences. The role of each of these is discussed. The need for re-assessment of new ideas about normal and pathological indicators by the entire medical-biological sciences complex is discussed and the need for caution in the introduction of scientific findings into the health field is emphasized. The special importance of such integration in regard to the eastern USSR is discussed in considerable detail.  
[592-2791]

UDC 61:001.89]:301

SOCIOLOGICAL STUDIES IN AREA OF MEDICAL SCIENCE ADMINISTRATION

Moscow VESTNIK AKADEMII NAUK MEDITSINSKIKH NAUK SSSR in Russian No 7, Jul 83  
(manuscript received 13 Jan 83) pp 41-45

FILIPPOV, O. V., Moscow

[Abstract] Analyses of responses to questionnaires by chairmen and scientific secretaries of USSR Academy of Medical Sciences problems commissions and

representatives of their subordinate institutes are presented and discussed. The questionnaires, initiated in 1976, cover a wide range of aspects of medical science administration and the relationship of scientists to it. Items discussed in this article include: evaluation of the role of scientific potential and scientific work administration in ensuring effectiveness of research, evaluation of the material and technical level of equipment used in scientific and technical research conducted in your specific collective, evaluation of the existing system of medical-biological research planning, evaluation of your own competence in medical science administration and evaluation of your colleagues' competence in this area. The findings from these questionnaires are used to compile directives of different kinds and to plan appropriate organizational measures in the work of USSR Academy of Medical Sciences scientific councils.  
[592-2791]

#### A LONG PATH

Moscow MOSKOVSKAYA PRAVDA in Russian 6 Jul 83 p 1

GAVRILIN, G., foreman of sanitary technicians of SU-69 construction company, SMYKOV, A., of the complex brigade team SU-79 and KOROCHKINA, Ye., MOSKOVSKAYA PRAVDA correspondent

[Abstract] The article discusses the delays in completion of a 500-bed clinic for the Moscow Scientific Research Institute for Pediatrics and Children's Surgery, begun in 1975 with money earned on "subbotniki" voluntary workdays and scheduled for at least partial completion by 1982. Failure to prepare the landscape for prefabricated construction procedures, poor management of different teams of specialized technical construction crews and distraction of even the basic construction crews to more "urgent" projects, such as schools, have prevented any meaningful progress beyond the shell of the building. All the missing work crews have apparently legitimate reasons for their distraction, so the question finally asked is why the Moscow Central Construction Office [GLAVMOSSTROY] undertakes twice as many projects as it can hope to complete. The effects on morale for future voluntary "subbotniki" is also considered.  
[579-12131]

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